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ANNOUNCEMENT.

Beginning with the next volume of the ELECTRICAL REVIEW the date of issue will be changed from Wednesday to Saturday. The first issue, therefore, in January will be dated January 5. There will be no change in the date of going to press, all forms of the ELECTRICAL REVIEW being closed Monday evening as heretofore. Special communications and changes in running advertising should reach us not later than the Saturday previous. This is made necessary by the increase in the size of the ELECTRICAL REVIEW and in the number of its subscribers.

THE OUTLOOK.

As the year draws to its close and business reaches the point of settling up and making ready to start fresh for a new year (and incidentally for a new century), the outlook is so promising that no one connected with the electrical industry can fail to be satisfied and happy at it. From every direction of activity in the widespread field of electrical endeavor we hear the same reports of large business, of factories working overtime to fill their orders, of contracts signed for export business, and, in general, of a wide development and increasing output. We have been rather in the way of neglecting our opportunities to secure export business because we have been so very busy with home business and with that that may be had without the asking. It is not improper, then, to call the attention of manufacturers to a fact which no one can deny and which is evident to any one who will take the trouble to look over the history of industrial affairs in the United States. Apparently, in this country, prosperity proceeds in cycles and these have a reasonably definite sequence so that when we see a period of stagnation followed by one of increasing activity we may know that for about four years business will be good and trade improving. Then we reach a season of high-water mark and after that the reaction. Just at present we are on the ascending slope of the curve and the outlook is all that can be desired by any one. In order that the usual reaction shall not follow this period of increased industrial movement we should carefully cultivate a foreign trade in places where, when the home market is bad, the chances are that the demand for goods will be lively and important. The plain English of it is that so long as we have tied ourselves down to home markets and home affairs we have had to withstand the effect upon our trade of conditions here, in a relatively small and narrow sphere, easily influenced by many circumstances over which we could bring no control to bear. When we shall have succeeded in making the world our market and the whole earth the scene of our endeavor we will be in a position where no local catastrophe and no crisis affecting one nation can have any hurtful effect upon us. While the manufacturer, crowded so that his plant is running night and day to supply the orders brought in to him without solicitation from his own neighborhood, may feel it is hardly worth while to give his attention to an export business, the time will surely come when he will look green-eyed with envy upon his British and German brethren who, despite hard times at home, are doing a large business supplying customers abroad. This is the position our manufacturers ought by right to be in and if they do not reach it it is their own fault.

ELECTRICAL DEPARTMENTS FOR STEAM RAILWAYS.

Since electricity has become so important a factor in the daily life of the world it has been found necessary in many directions of activity to create electrical departments. For example, no city government is to-day complete without an electrical bureau, nor can any large manufacturing enterprise, especially if engaged in metallurgical trades, afford to get along without competent assistance in electrotechnical matters. The same remarks apply with equal advantage to main-line railways and it is a matter for some wonder that the trunk line systems of this country have not sooner organized full electrical engineering departments.

Outside of the immediate and apparent necessity for electrical control of signals, switches, of train despatching through the telegraph, of lighting and of instantaneous communication about the various departments of offices, yards, shops and termi-

nals, there is the absolute certainty that within a few years the main portion of the operative equipment of main-line railways will be worked by electricity. Unless railroads go about forming their electrical engineering departments they will be in greater or less measure dependent upon the advice of outside men, largely, perhaps, incompetent with reference to the special work that they will have to undertake. If the railroads will forget for a moment the conservatism which has marked their course for decades past and look forward to the evident necessity that confronts them they will see at once the usefulness of establishing and maintaining competent departments of electrical engineering, not only to take charge of the work that is before them to-day but also to prepare for the future and for the change in motive power and equipment that is certain to take place.

The need for such departments is sufficiently obvious to make the wise and enterprising steam railway manager consider the importance of going ahead and organizing corps of men trained in railway matters and able to cope with electrical questions that will shortly come up for solution. It will not be many years before the entire steam equipments of our main-line railroads will be obsolete, and it would be the part of wisdom for the far-seeing and well-equipped railroads to look ahead to that day and prepare for the forthcoming change in the best possible way—by instructing in the technique of railroading men that will be competent to oversee the change-over from steam to electric motive power.

THE STEAM TURBINE.

On another page of this issue begins a highly instructive article by Mr. Francis Hodgkins on the steam turbine. This subject is one with which electrical engineers should hasten to familiarize themselves for the reason that the promise of the steam turbine to-day is very great and the outlook for its future such that it may reasonably be expected to take the place shortly of other forms of steam motive powers for electric driving.

The turbine possesses large and important advantages over reciprocating forms of steam engines for dynamo driving. It has no dead-points; it has no variations of speed within the length of its stroke, because it has no stroke; it is a fairly economical motor; its normal rate of rotation is so high that it will bring us back to the easier and simpler design of machinery which has largely been supplanted in the effort to couple dynamos direct to engines of the slower type now in use. To any one who looks back over the history of the influence on the steam engine of electric products it is evident that the speed of engines has been decreased and many special alterations made in their design to fit them for direct coupling with large electrical units. The nature of the dyname is such that it is normally a high-speed machine. With a given frame and weight, the faster the machine runs the greater is its output, while the floor-space and house-room occupied are identical. Already in large central stations for city use there is a tendency toward increasing speeds to save the great first cost and large space occupied by direct-coupled units. It is impossible to make economically, conveniently and simply a steam engine of very large rated horse-power to run at large rotational speeds, because the mechanical difficulties involved in operating reciprocating machinery at high velocity are of the very greatest. Ever since the days of James Watt it has been hoped that some rotary form of steam motor, having a constant torque throughout its whole circumference of rotation, could be produced, and this we seem to have reached in the modern turbine. Nothing could be simpler or more convenient for the parallel operation of alternating-current machinery, while a host of special problems that have been introduced in this important field of work by the incapacity of the piston engine will disappear before the advent of turbines running under even torque at high speeds. What can be done under limiting conditions of space and weight by these machines has already been spectacularly illustrated in the performance of the turbine-driven torpedo craft lately made in England. The elimination of vibration and shock and the saving of floor space are features that will be highly important in power plants and installations located within the densely populated portion of cities. At the same time the simplicity of the machine, its ease of control, its absence of reciprocating parts and mechanical movements all combine to make it a machine of utility, simplicity and satisfaction for central station use.

The British medical journals report the death of a patient, a woman of mature years, from the consequences following a severe X-ray burn received while undergoing examination for the fracture of an important bone. It appears that the patient was burned quite severely and was in such a low state of health owing to the accident which gave reason for the examination that she did not rally and sank into a condition from which, after the process of considerable time, she died. While it is deeply to be regretted that this first fatal accident, which may justly be attributed to the X-ray, has taken place, it serves admirably to point a strong moral in that X-ray examination should be entrusted only to those sufficiently skilled in the art to guarantee immunity from burns. In other words, an X-ray burn at this time is entirely unjustifiable and there is no sort of proper excuse for such an accident. Examinations with these rays are made daily and in increasing numbers in our larger cities by people sufficiently skilled and experienced so that burns are practically certain not to occur. Of course, such a case as this we have mentioned will produce locally an outcry against the use of the X-ray, but a wiser public opinion would confine the complaint to the ignorance of the practitioner who injured his patient, and would recognize that where one accident takes place thousands of patients are immensely benefited and in many cases limbs and even lives are saved.

A correspondent suggests that the winking of lights in trolley cars when these pass a break in the working conductor is exceedingly disagreeable and that the use of a storage battery aboard the car and connected with the lighting circuit would not only obviate this trouble, but leave the car illuminated when current happens to go off through some accident or when the car itself is injured. If storage batteries did not cost anything the suggestion would be excellent, but as the majority of trolley cars work at an electrical pressure of about 500 volts, it is readily evident that more than 200 cells of accumulator would be required aboard of one to furnish lights for these brief intervals, and that such an outfit would cost far more than it is actually worth in practice.

Science Brevities

Electrical Dispersion — Confined Air — Professor H. Geitel has lately undertaken some interesting studies on electrical dispersion in confined air. His observations were made upon a hermetically sealed vessel containing an electrode. His first result was that dispersion gradually increases in the course of several days, which goes far to disprove the assumption that a given volume of air is only capable of discharging a limited quantity of electricity. It is now known that dust floating in the air hinders rather than helps electrical dispersion and the author attributes the results he has attained to the fact that this dust is gradually laid. If that deserving factor is allowed for it appears that the rate of discharge is constant and that the quantity dispersed in a given time is independent of the volume and of the dependent conditions, so long, at least, as the latter ranges between 80 and 240 volts. The author assumes that a definite number of ions is regenerated in a unit of time in the confined air space. The phenomenon seems to resemble somewhat the case of a clock which runs along at a certain definite rate, no matter what the tension of its spring may be.

Wireless Telegraphy—Some interesting experiments have recently been carried out in Germany by Professor Braun, of the physical laboratory of the Strasbourg University. The experiments have been made with the object of increasing, if possible, the range to which these wireless telegraphy messages can be despatched. Up to the present, however, the statements made by the authorities in Berlin do not disclose any claim for distances as great as have been successfully signalled over by Mr. Marconi. The experiments were made between the Brocken (the highest mountain in North Germany) and the Kyffhauser (in Thuringia). The actual distance was about 40 miles, and messages were successfully transmitted and received. Up to the present only untechnical descriptions have been given, from which it is not easy to understand exactly what the arrangements are. It seems, however, says the London *Electrical Engineer*, that there is a transformer between the discharge circuit of the condenser and the circuit in which the oscillatory currents sending the message are induced. The professor's system is also in use between Cookshaven and Heligoland, a distance of about the same length, and it is said to work well. As regards the Marconi system in our own country, it is being boomed quite as much as ever in the daily papers. Without doubt the company has the right to manage its own affairs in the way it likes, but the methods adopted are not those which recommend themselves to scientific men. It may be advisable from their point of view to withhold information from those who are able to judge of the value of the system, but this should not be accompanied by very numerous interviews with the editors of half-penny papers, who draw quite erroneous conclusions. A perusal of the remarks made by the interviewers, as published in several papers during the past week, would lead the untechnical man to conclude that it is only the obstinacy of the Post Office officials which prevents the Marconi system displacing the ordinary systems of telegraphy in the British Islands. Even this faulty conclusion would be harmless were it not for the fact that it may result in the public paying fancy prices for the shares in the Marconi Company. In certain situations the Marconi system of telegraphy is useless, and there has been nothing done up to the present which shows any signs of enabling it to compete with ordinary telegraphy over land lines, or even with submarine cables, unless the conditions are exceptional—as, for instance, when connecting between the mainland and an isolated lighthouse round which a violent sea washes. An example of the telegraph we refer to is one which has just reached us in connection with experiments to be carried on from Southend Pier. We are informed that automatic signals are to be continuously sent from a 30-foot mast erected on the pier, which signals are intended to warn steamships coming into the Thames in a fog of their danger. To give weight to the note, one is told that experts from the Board of Trade, Trinity House, Lloyd's, and other public and private corporations are to witness the trials. The fact remains, however, that although in a fog the signals may be received on board a boat, the occupants of that boat will be unable to know either in what direction the danger is or the distance they are away from the sandbank or rock from which the warning is supposed to issue.

Shiplighting—A long article in the *Elektrotechnische Zeitschrift* by Mr. Grauert deals with electrical installations on new ships of the German navy. It appears that in the German service separate lead and return wires have been generally adopted, concentric cables being used in the neighborhood of the ship's compasses. Attempts to employ the ship's structure as a return have not conduced to successful results, and so far as large vessels are concerned, this practice has been entirely superseded. But in the case of new torpedo boats, where economy in weight is a vital consideration, the practice still holds. In all places exposed to the danger of mechanical injury, such as the engine-rooms and stokeholds, lead-covered, iron-armored cables are employed, while elsewhere cables well insulated with rubber, but otherwise unprotected, except in some cases by thin rustproof wire, are used. The wood casing formerly employed has been abolished, owing to its inflammability. Hitherto the telegraph and telephone cables have been of the lead-covered, iron-armored type, but the newest ships have been provided with a central subway, like a corridor, as well as side corridors below the armored deck, which may be used for the electric cables, telegraph and telephone wires, etc., thereby avoiding all danger of mechanical injury to the same. Having regard to this, it is proposed to dispense with the steel armor in future, even for the lighting and power cables, retaining only the lead protection. The practice of soldering branch connections has also been discarded in favor of branch fuse boxes, in which the connections are made to terminal bars. These branch circuit boxes are made for two, three, four, six and eight lamps. They are, of course, watertight. Their introduction seems to have been a complete success, facilitating, as they do, systematic supervision of the ship's wiring. Although slate is at present generally used for switchboard bases in the service, it is interesting to learn that iron is proposed as a substitute, owing to the unavoidable breakages which occur. Small machine boards with iron bases have already been successfully introduced, but the difficulty of insulating the terminals and connections has hitherto prevented the adoption of the plan on a large scale. With the exception of the connections to the measuring instruments, all the switchboard connections on the Fürst Bismark were for the first time made with bare copper bars, whereby a neat, solid construction is obtained, which is also accessible. The necessary protection against moisture is provided by enamel, which also serves to distinguish the poles, red and blue being used. This type of board is particularly advantageous where the available space is limited in depth, since the connections behind require no supervision, and the screw terminals may all be withdrawn from the front of the board.

THE THEORY OF ALTERNATING DYNAMO-ELECTRIC MECHANISMS—IX.

BY W. ELWELL GOLDSBOROUGH.

By the aid of a planimeter the area included between the power curve, ($e\ i$) taken for the time of half the period, since it repeats itself every half period, and the horizontal axis has been found to be 3.8 square units, and since the time length of the half period is *three* units, and one vertical inch equals 2000 watts the,—

$$\text{The mean power} = \frac{3.8}{3}\,2000 = 2533 \text{ watts.} \qquad (94)$$

Now suppose we attempt to determine the mean power by substituting in equation (91) values of $\bar{E}$, $\bar{I}$ and ϕ determined from Fig. 27. The area included between the curve of "square" volts (e^2), and the axis, taken for half a period, is 7.5 square units, as determined with a planimeter; therefore

$$[\text{mean}]^2_{\frac{1}{2}}\,e = \frac{7.5}{3}\,2000 = 5000,$$

and

$$\bar{E} = \sqrt{5000} = 70.71 \text{ virtual volts.} \qquad (95)$$

The area included between the curve of "square" amperes (i^2), taken for half a period, and the axis, is 2.76 square units, as determined with a planimeter; and

$$[\text{mean}]^2\,i = \frac{2.76}{3}\,2000 = 1840,$$

and

$$\bar{I} = \sqrt{1840} = 42.9 \text{ virtual amperes.} \qquad (96)$$

In determining the angle of lag of the current we have to approximate the true result as the current curve is considerably distorted. Suppose we take the time interval between the instants when the electro-motive force and current attain their maximum values as a measure of this angle of lag. This method of determining ϕ is perfectly correct when the waves are pure sine curves, as may be seen by referring to Fig. 22. In Fig. 27, the distance between the maximum electro-motive force and maximum current ordinates is .8 unit, and since one-half the period length is 3 units,—

$$\phi = \frac{.8}{3.0}\,180^\circ = 48^\circ, \qquad (97)$$

by this determination.

Substituting these values in equation (91) we get the,—

$$\text{mean power} = \bar{E}\bar{I}\cos\phi = 70.71 \times 42.9 \times \cos 48^\circ = 2030 \text{ watts,} \qquad (98)$$

which is 19.8 per cent less than the true result obtained in equation (94). From the result just obtained it is evident that the method used in determining the angle of lag will not answer, as it gives too large a value for ϕ.

When dealing with irregular wave-forms, as in the present case, it is often desirable to determine the amplitude and phase of the sine curve that most nearly approximates the given wave, and such a sine curve is called the "Equivalent [Sine] Curve" of the wave considered. Fortunately the majority of commercial alternators generate electro-motive forces that are practically sine curves and are represented sufficiently well by a sine curve whose maximum ordinate coincides with the maximum ordinate of the electro-motive-force curve, and which has the same virtual value as the electro-motive-force curve.

This being the case there is a very convenient method of determining the "Equivalent-Current Curve," and it will be shown later that the result so obtained [see equation (120)] is very nearly theoretically correct.

To determine the equivalent-current curve and angle of current lag when the electro-motive-force curve is harmonic; determine from the power curve the rate at which energy is supplied the circuit (the mean power), and determine also the virtual values of the electro-motive force and current. If (i) were a simple sine function the equation,—

$$\bar{E}\ \bar{I}\cos\phi = P = \text{the mean power,}$$

would give a true result; if, therefore, we substitute the values of $\bar{E}$, $\bar{I}$ and the *mean power* obtained above, in this equation, we can solve for $\cos\phi$, and finally obtain the value of the angle ϕ_1 of lag of the equivalent-current curve.

The equation of this current curve will be,—

$$i_1 = I_1 \sin(\omega t - \phi), \qquad (99)$$

in which $\bar{I}_1 = \bar{I}$ and $I_1 = \bar{I} \div .707$, and will represent an accurate sine curve approximation of the current flowing.

Applying this method to Fig. 27 we find that a sine curve having an amplitude equal to $\bar{E} \div .707 = 100.02$, and expressed by the equation,—

$$e_1 = 100.02 \sin \omega t, \qquad (100)$$

practically coincides with the electro-motive curve e.

Substituting $\bar{E}$, $\bar{I}$ and the mean power in equation (91),—

$$\cos\phi_1 = (2533) \div (42.9 \times 70.71) =$$

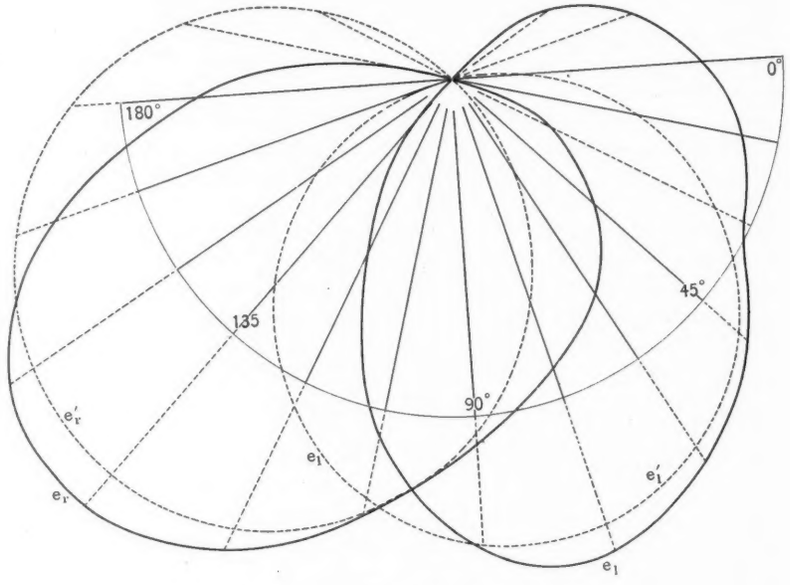


FIG. 28.—ALTERNATING-CURRENT MECHANISMS.

.835, therefore $\phi_1 = 33^\circ\ 23'$, (101) and the equivalent-current curve is represented by the equation

$$i_1 = (\bar{I} \div .707) \times \sin(\omega t - 33^\circ\ 23') = 60.68 \sin(\omega t - 33^\circ\ 23'),$$

and is the curve marked i_1; it has the same power effect as the curve marked i; i. e., as the actual current.

The maximum value of the equivalent-current curve is $65 - 60.68 = 4.32$ amperes less than the maximum value of the current, and occurs $48^\circ - 33^\circ\ 23' = 14^\circ\ 37'$ earlier in the cycle. This angle of $14^\circ\ 37'$ is the angle of lag of the magnetism behind the current, since in circuits in which the induction coils contain iron cores, the maximum value of the magnetism and the maximum value of the current occur together owing to the peculiar shape of hysteresis loops. In Fig. 29 the curve marked Φ is the curve of magnetization created by the current i, as is to be expected it is similar to the curve of impressed electro-motive force. In Fig. 30

the curve marked Φi is plotted with the values of the magnetization used as ordinates and the values of the current used as abscissae for successive increments of time. The area of this curve is proportional to the power dissipated in hysteresis.

Having developed this matter along "practical" lines, by the application of the usual "working" methods, we will now investigate the subject from a theoretical standpoint.

When the equation of an irregular wave is known in terms of a Fuorier's series, i. e., in terms of the sum of its principal function and harmonics, its virtual value is readily determined, since—

$$c\,x) - \cos\,(x + c\,x)]\,dx$$

$$= + \frac{1}{2}\int_0^{2\pi} \cos\,(1 - c)\,x\,dx - \frac{1}{2}$$

$$\int_0^{2\pi} \cos\,(1 + c)\,x\,dx$$

$$= - \frac{1}{2}\left[{}^{2\pi}_{0} \frac{\sin\,(1 - c)\,x}{1 - c} + \right.$$

$$\frac{1}{2}\left[{}^{2\pi}_{0} \frac{\sin\,(1 + c)\,x}{1 + c} = 0.\right.$$

See equation (67).

In the same way, by extending the proof, it can be demonstrated that for the complex harmonic,—

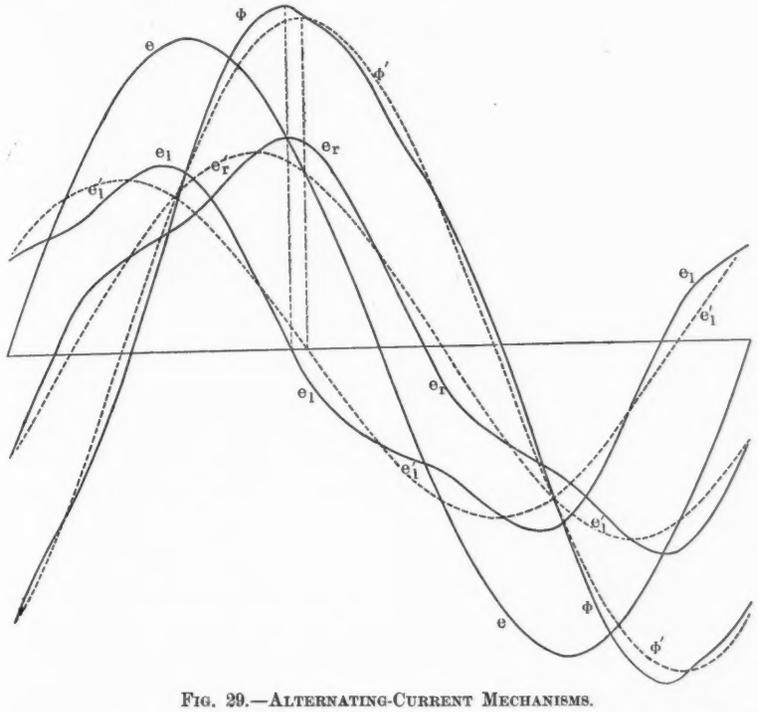


FIG. 29.—ALTERNATING-CURRENT MECHANISMS.

The "virtual" or $\sqrt{\text{mean}^2}$ value of any complex harmonic function is equal to .707 times the *square root of all its constant terms.*

For suppose we consider a harmonic function of the form,—

$$y = \text{A}\sin x + \text{B}\sin c\,x, \qquad (102)$$

then the

$$[\text{mean}]^2\,y = \int_0^{2\pi} \frac{(\text{A}\sin x + \text{B}\sin c\,x)^2\,dx}{2\pi}$$

$$= \frac{\text{A}^2}{2} + \frac{\text{B}^2}{2} = .5\,(\text{A}^2 + \text{B}^2) \qquad (103)$$

since

$$\int_0^{2\pi} \text{A}^2 \sin^2 x\;dx =$$

$$\left[{}^{2\pi}_{0} \text{A}^2\left(\frac{x}{2} - \frac{\sin^2 2\,x}{4}\right) = \pi\,\text{A}^2,\right.$$

and

$$\int_0^{2\pi} \sin x \sin c\,x = \frac{1}{2}\int_0^{2\pi} [\cos\,(x -$$

$$y = \text{A}\sin\,(a\,x + \theta_a) + \text{B}\sin\,(b\,x + \theta_b) + \text{C}\sin\,(c\,x + \theta_c) + \ldots\ldots + \text{U}\sin\,(u\,x + \theta_u) + \ldots \text{ the } [\text{mean}]^2\,y = .5\,(\text{A}^2 + \text{B}^2 + \text{C}^2 + \text{D}^2 + \ldots\ldots + \text{U}^2 + \ldots), \qquad (104)$$

and that, therefore,—

$$\sqrt{\text{mean}^2}\,y = .707\sqrt{\text{A}^2 + \text{B}^2 + \text{C}^2 + \text{D}^2 + \ldots\ldots + \text{U}^2 + \ldots} \qquad (105)$$

Frequency constants, phase angles and + and — signs do not effect the result in the least as they only influence the *phase*, i. e., the relative *lateral position* of the harmonics and *not* their *average* values.

In dealing with many irregular waveforms, when the harmonic equation of the curve is unknown and it is not convenient to determine it, the following method of obtaining the virtual value of the wave is suggested, as it is more readily applied than the method employed in Fig. 27 of plotting a curve of "squares" and then finding the $\overline{\text{mean}^2}$ by integrating the area and dividing by the base line or equivalent period length.

The "virtual" or $\sqrt{\text{mean}^2}$ value of any wave-form can be determined by plotting the instantaneous values of the wave in polar coordinates, i. e., as radii corresponding to the time as angle, for the area of the curve constructed in this way, multiplied by .6366, is equal to the mean square of the given wave.

Suppose the equation of the curve be of the form,—

$$y = \text{A}\sin x + \text{B}\sin c\,x, \qquad (102)$$

then the area (A_p) of the polar curve will be,—

$$\text{A}_p = \frac{1}{2}\int_0^{\pi} r^2\,d\,\theta = \frac{1}{2}\int_0^{\pi} y^2\,d\,x =$$

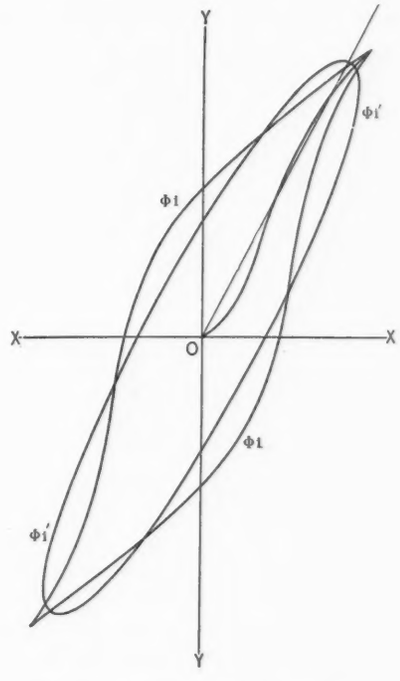


FIG. 30.—ALTERNATING MECHANISMS.

$$\frac{1}{2}\int_0^{\pi} (\text{A}\sin x + \text{B}\sin c\,x)^2\,dx \qquad (106)$$

since, $r = y$ and θ equals the phase angle represented by x.

By applying the methods of the previous demonstration in the integration of (106), we find,—

$\text{A}_p = \frac{\pi}{4}\,(\text{A}^2 + \text{B}^2)$, and therefore the

$$[\text{mean}]^2\,y = .5\,(\text{A}^2 + \text{B}^2) = \frac{2\,\text{A}_p}{\pi} = .6366\,\text{A}_p. \qquad (107)$$

This proof may be extended to the general equation (104) given above, which expresses the value of any wave motion, and it can be shown that the area of its polar diagram, plotted as explained above, is

$$\text{A}_p = \frac{\pi}{4}\,(\text{A}^2 + \text{B}^2 + \text{C}^2 + \text{D}^2 + \ldots\ldots + \text{U}^2 + \ldots) \qquad (108)$$

therefore,—

$$[\text{mean}]^2\,y = .6366\,\text{A}_p. \qquad (107)$$

THE STEAM TURBINE—I.*

BY FRANCIS HODGKINSON.

The earliest records of steam engineering are to be found among the relics of ancient Egypt. About 120 B. C. Alexandria was at the zenith of her civilization. At this time Hero, probably contemporary with Euclid and Archimedes, wrote his celebrated work, "Spiritalia Seu Pneumatica." In it he described several forms of mechanical apparatus. The use of the steam jet for accelerating combustion; the expansion of air when heated in a closed vessel; several forms of steam boilers; various hydraulic apparatus for opening and closing temple doors. The most interesting among all these is described a reaction steam turbine. It consisted of a boiler, above which is a sphere mounted upon two trunnions. By means of these, steam is admitted to the interior of the sphere. On the equator were attached two bent pipes, such that the issuing steam reacted upon the sphere and caused it to revolve about its trunnions.

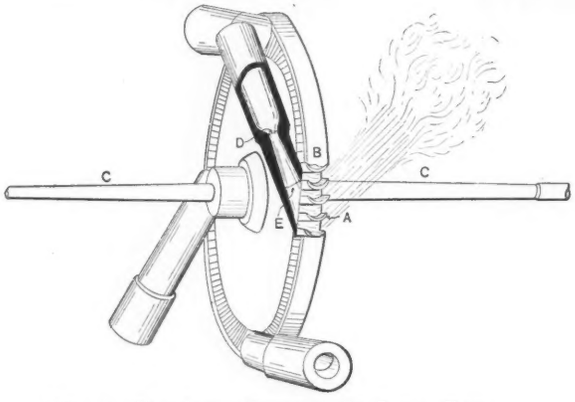


FIG. 1.—THE STEAM TURBINE—DE LAVAL TYPE.

It is unknown whether this engine was ever more than a mechanical toy, although it is very possible it may have been used by the priests for driving so-called magical apparatus where high speed was desirable.

The next turbine, capable of any practical development, and which may be regarded as the forerunner of the de Laval turbine, was invented by Bianca in 1629. It consisted simply of a jet of steam impinging upon the vanes of a paddle-wheel and blowing it around.

A century later, 1705, the reciprocating engine appeared, and from that time until the last few years, practically nothing was done in the development of steam turbines.

Before leaving this brief historical review, it is interesting to record that Mr. Parsons, with a view of exploring the possibilities of a reaction steam turbine, constructed one on the lines of Hero's engine. The sphere was replaced by two hollow oval sectional arms, mounted upon a hollow shaft, with jets at the outer ends, through which the steam issued tangentially to the plane of motion. The whole was enclosed within a cast-iron case and connected to a condenser.

With 100 pounds per square inch at the jets, and 26 inches vacuum in the exhaust casing a speed of 5,000 revolutions per minute was attained and 20 horsepower developed. The consumption of steam was 40 pounds per brake horsepower.

It is not a little remarkable that the latest development of steam engineering should be returning to the earliest form of engines of which we have record. It is still more remarkable that the engine, as described by Hero, had greater economy than any steam engine produced for 18 or even 20 centuries later.

The fundamental principle of the steam turbine in contradistinction to the reciprocating steam engine lies in the fact that the latter does work by reason of the static expansive force of the steam acting behind a piston, while in the former case the work is developed by the kinetic energy of particles of steam which are given a high velocity by reason of the steam expanding from one pressure to a lower.

Steam turbines may be divided into three classes:

1. Impact, of which Bianca's is an example.

2. Reaction, of which Hero's is an example.

3. A combination of both of these, of which Parsons's is an example.

It is proposed in this paper to deal only with the two forms which have attained some degree of commercial success; namely, the Parsons and the de Laval, particularly the former.

The general principles made use of in water turbines also apply to steam turbines. The buckets and guides must have as little skin friction as possible, and so arranged that the acting fluid may strike without sudden shock, and have its direction of motion changed without sharp angular deflections. One difficulty, however, presents itself, and is due to the tremendous velocity of steam as compared with that of water under ordinary heads.

The laws governing the best velocity of buckets are the same as for water-wheels. In the impact turbine the ideal condition is when the peripheral velocity of the buckets is one-half that of the fluid comprising the jet. In the reaction turbine this velocity must be equal to that of the jet in order to give us this ideal condition. Now with high-pressure steam discharging into a vacuum the velocities obtained are from 3,000 to 5,000 feet per second, as calculated by Zeuner's formula.

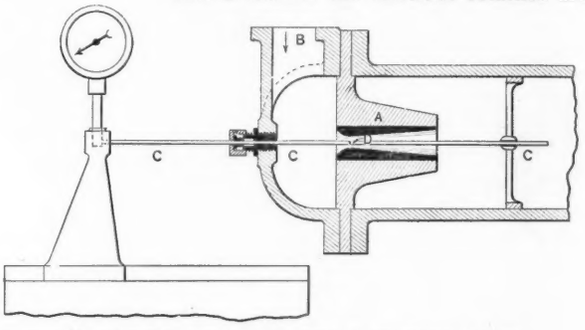


FIG. 2.—THE STEAM TURBINE—EXPLORING GAUGE.

A turbine, therefore, built on the lines just enumerated would have peripheral velocities far beyond the limits of strength of material. As an example, a 10-inch Hero's engine would revolve at 75,000 revolutions per minute.

The de Laval turbine, shown on Fig. 1, consists of a divergent nozzle which directs the jet of steam upon suitably formed buckets A which are attached to the periphery of a revolving wheel. The outer edge of the buckets is shrouded by a steel ring B which prevents the centrifugal escape of the steam. The unique features of this turbine are the nozzle and the means by which the wheel is enabled to revolve upon its axis of gravity.

With regard to this latter point a difficulty always arises in attempting to revolve a body at a high rotative speed. It is essential in the first place that the body be accurately balanced, but in spite of all care this can not be attained with absolute accuracy. The result is that with ordinary shaft and bearings, tremendous vibrations would be set up that would probably result in eventual rupture of the shaft. De Laval overcomes this difficulty, however, by mounting his wheel near the centre of

* A paper read before the Engineers' Society of Western Pennsylvania.

a long, light shaft C capable of being considerably bent and returning to its original form. The shaft is mounted upon bearings of ordinary construction. This flexibility enables the forces set up by the revolving wheel to deflect the shaft and

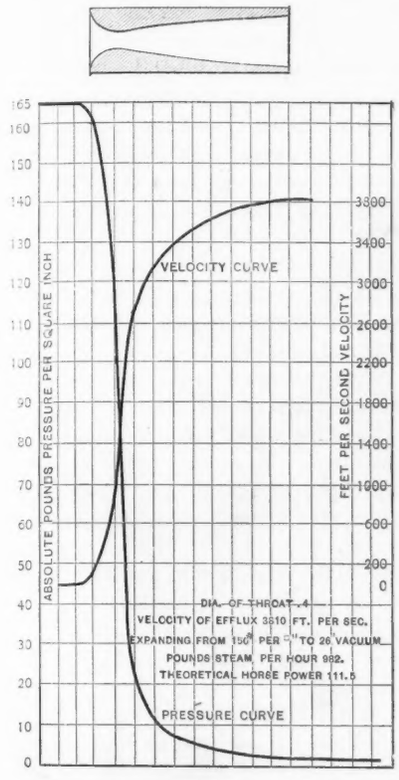

ABSOLUTE POUNDS PRESSURE PER SQUARE INCH
FEET PER SECOND VELOCITY
VELOCITY CURVE
DIA. OF THROAT .4
VELOCITY OF EFFLUX 3610 FT. PER SEC.
EXPANDING FROM 150 PER " TO 26 VACUUM
POUNDS STEAM PER HOUR 982.
THEORETICAL HORSE POWER 111.5
PRESSURE CURVE

FIG. 3.—THE STEAM TURBINE.

enable the former to revolve about its axis of gravity.

The nozzle is divergent. In it the whole expansion of the steam is carried out. The steam at the mouth of the nozzle has the same pressure as the exhaust. In other words, the steam has its energy completely transformed into mass and velocity by the time it comes in contact with the buckets.

This brings up another feature of the turbine, and is, that, with the exception of the nozzles and the throats of the nozzles, no parts are subjected to steam pressure. It is well known that the velocity of steam flowing through an orifice, from a greater to a lesser pressure, increases as the difference of the pressure increases, only up to a certain limit. This limit is reached when the lower pressure becomes less than fifty-six one hundredths of the higher. Beyond this, however much the steam pressure is increased, the velocity of steam remains practically the same—about 1,476 feet per second. This limit of velocity is an anomaly, which seems to have been never satisfactorily explained. It is probably due to the fact that the pressure in the centre of the throat is not the same as in the surrounding medium. The jet, after passing the throat, suddenly expands and the change of direction of the fluid particles gives rise to centrifugal forces. Experiments all show that a jet, discharging from a reservoir of high pressure into a lower pressure, where the difference is greater than 56:100, that the pressure in the throat of the nozzle is always equal to fifty-six one hundredths of the absolute pressure of the reservoir, no matter how great may be the difference between the two pressures.

The action of steam in the nozzle may be shown by further illustration.

In this case if the reservoir were filled with water the velocity issuing would be found by the formula $V^2 = 2\,g\,h$ where h is

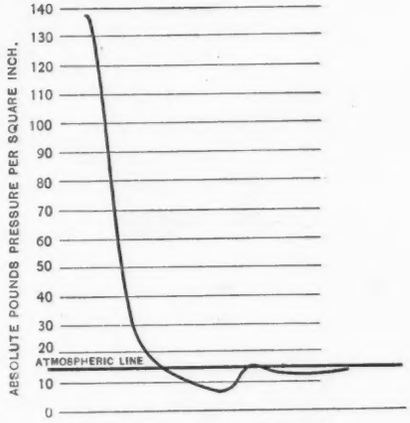


FIG. 4. THE STEAM TURBINE.

the actual feet head of water above the nozzle. In the case, however, of the fluid in the reservoir being steam or gas instead of water, h must be changed to an ideal head, which is the column of fluid necessary to give the given pressure at the level of the nozzle. This ideal head is equal to the feet head of water necessary to give the pressure, multiplied by the density of the water and divided by the density of the fluid in the reservoir. This formula, however, is only approximate, and is only good up to the before-mentioned limits.

With small differences of pressure, such that P_m is greater than $.56P_n$, the fluid will issue with a velocity varying with the square root of the ideal head, which will increase as the difference of pressures increase, until we reach the before-mentioned condition of maximum discharge, and up to this point the steam will issue from the nozzle in substantially straight lines; this of course providing the nozzle has a well-rounded entrance, and is not a condition that might be termed "an orifice in a thin plate."

When the pressure is increased beyond this, the steam expands partially outside the nozzle, and the particles cease to issue in a straight line as before. This subsequent expansion is taken advantage of by de Laval by means of his divergent nozzle, which is of the form shown in Fig. 1.

The throat is at D, having a well-rounded entrance, and from there on the nozzle diverges. The relation of the area of the outlet at E to the area of the throat at D should satisfy the equation:

$$\frac{F_m\,W_m}{V_m} = \frac{F_2\,W_2}{V_2}$$

F_m = sectional area of the throat.
F_2 = " " " " outlet.
W_m = velocity of steam at throat.
W_2 = " " " " outlet.
V_m = specific volume of steam at inlet.
V_2 = " " " " " outlet.

This equation simply states that equal weights of steam pass at both the throat and the outlet in equal intervals of time.

Practically a nozzle must be made with the area at the exhaust end as small as possible, for the sake of getting the greatest

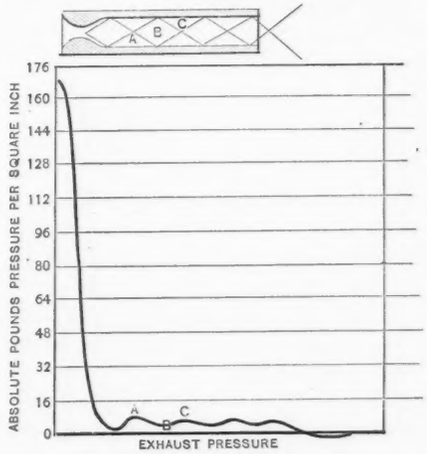


FIG. 5.—THE STEAM TURBINE.

velocity, but just so large that the pressure will not be higher than that of the exhaust pipe.

The best length of nozzle is hard to determine. If too long there will be considerable loss of velocity due to skin friction. At the same time it must be long enough to admit of proper expansion of the steam. The best shape of the divergency has been the subject of investigation by various experimenters, in order to give the best expansion curve, regarded as a single particle. The writer's opinion is that the best results in this respect are obtained by

a nozzle whose section is very near an ellipse.

The investigation of the performance of steam nozzles is particularly interesting, the apparatus usually employed is shown in Fig. 2.

The nozzle for the experiment is at A; the steam entering at B discharges through the nozzle directly into the exhaust pipe. At C is provided a small searching-tube, sealed at one end and with a minute hole D some distance from this end. At the other end is provided a suitable pressure gauge or mercury column. Means are provided for sliding the searching-tube with its pressure gauge back and forth, when pressures may be read with the hole in the searching-tube in different positions throughout the length of the nozzle. From these figures a curve of pressures may be developed and from this, together with knowledge of the weight of the steam passing the nozzle per unit of time and the exact form of the nozzle, a second curve may be developed which will give some idea of the velocities of the fluid.

The curves on Fig. 3 give an example of this. They have, however, been developed theoretically on a basis of adiabatic expansion, that all the energy of the steam between the limits of pressure; *viz.*, 150 pounds gauge pressure and 26-inch vacuum has been converted into velocity and that there are no losses due to skin friction or through loss of pressure by low coefficient of efflux. This coefficient of efflux is a feature of the entrance to the nozzle and varies from 50 per cent in an orifice in a thin plate to 98 per cent in a well-rounded orifice, as is shown in Fig. 3.

The pressure curve is an adiabatic expansion line from the throat to the outlet, and the pressure of the throat .56 times the absolute pressure of the steam before entering the nozzle.

The velocity at the mouth of the nozzle is shown to be 3,810 feet per second and 982 pounds steam passing per hour; diameter of throat, four tenths inch; theoretical horse-power, 111.5.

In actual practice as much steam as this could not be made to pass for the reasons just given, so the nozzle would require some modification in consequence.

Of course, in these investigations allowance must be made for the area of the searching-tube. Fig. 4 shows an actual example of a nozzle designed for discharging into vacuum, but used for discharging into atmospheric pressure, and shows how the steam reaches near the condition of vacuum near the outlet and afterwards rises to the exhaust pressure.

This feature is, to a certain extent, taken advantage of in a de Laval turbine, designed for running non-condensing. The nozzle is slightly over-compounded so that the wheel may revolve in a partial vacuum. Some gain in economy is the result, by reason of the wheel revolving in a less dense medium.

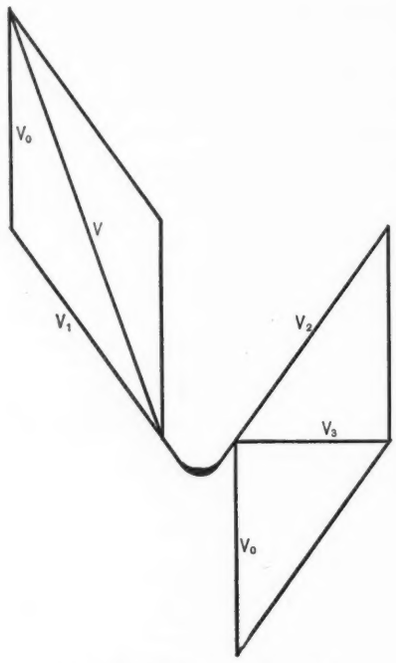


Fig. 6.—The Steam Turbine.

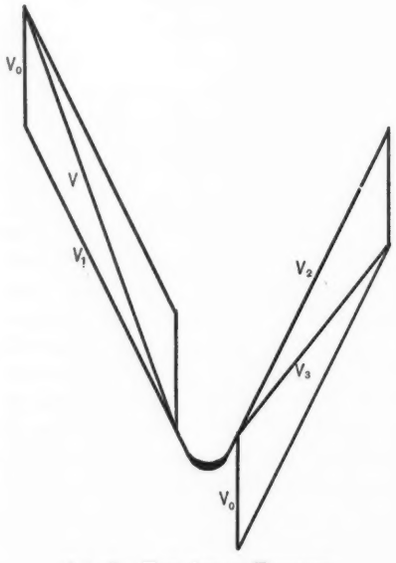


Fig. 7.—The Steam Turbine.

Fig. 5 shows rather a curiosity. This form of nozzle was suggested as being as suitable as any that might have carefully constructed curved walls, and that the steam itself would take the correct passage and give the same results, so long as the correct ratio of throat area and outlet area were maintained. It will be observed how the pressure line forms waves, which exactly correspond with some lines shown in the nozzle, which appear as though the steam particles fall very near to the exhaust pressure immediately on leaving the throat. They strike the walls and rebound, meeting together at the point A, when they form a point of pressure, again striking the walls at B, meeting again at C, and so on.

In the de Laval turbine, the nozzles are set at an angle of 20 degrees with the plane of motion of the buckets, which is as accurate an angle as is possible.

The action of the steam on the buckets may be shown by the diagram of parallelogram of velocities, Fig. 6, which shows an ideal condition which could seldom be obtained in practice.

V is the direction and velocity of the steam issuing from the nozzle.

V_o is the velocity and direction of the buckets.

Component V_1 is the relative angle and velocity with which the steam strikes the bucket.

V_2 is the *relative* direction and velocity of the steam leaving the buckets.

V_3 is therefore the *absolute* direction and velocity of the steam leaving the buckets.

It will be observed here that V_3 is a horizontal line, so that the combination is one of maximum efficiency, the only losses being due to the angularity of the nozzle.

By reason of the tremendous velocities of steam, a diagram, similar to Fig. 7, is what is generally obtained in practice. It will be noted that the angle of the bucket at the entrance corresponds with that of the component V_1. It is usual to have the angle of outlet making an angle with the plane of motion equal to that of the inlet with the same plane, thus taking away practically all end sizes, are equipped with several nozzles, thrust.

These turbines, especially the larger sizes, are equipped with several nozzles, some of which are provided with independent stop-cocks, such that the number of nozzles in operation may be adjusted to suit the condition of running, in order to obtain the most suitable steam pressure in the throats.

These turbines are essentially of very high speed. The smaller sizes run about 30,000 revolutions per minute, and are geared down to about 3,000; the larger sizes about 10,000 revolutions per minute. The peripheral speed of the wheel is usually from 600 to 1,200 feet per second. The reduction of speed is accomplished by

means of a pair of helical spur gears with the angle of helix 45 degrees.

These gears form by far the biggest part of the whole outfit. The remaining portions of these turbines have no remarkable features. The regulation is effected by means of a flywheel governor which is on the slower-running shaft and wire draws the steam at the admission.

Some tests of a 10-horse-power turbine were communicated to the American Society of Mechanical Engineers in 1896, in which the turbine described had four nozzles of .138 diameter and one of .157 diameter of throat. The nozzles were two inches long from throat to outlet.

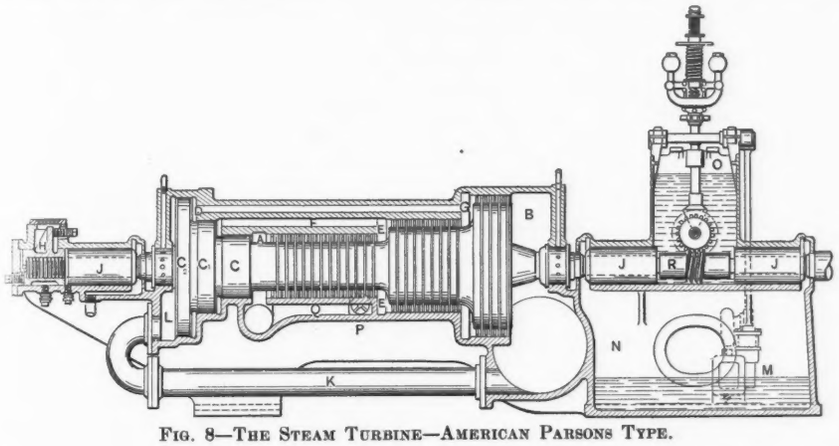


FIG. 8—THE STEAM TURBINE—AMERICAN PARSONS TYPE.

The speed of the turbine was 23,771 revolutions per minute, reduced by gearing to 2,400, the economy full-load, non-condensing was 47.8 pounds per British horse-power. The economy is by no means bad when the small power of the outfit is considered.

In December, 1899, some tests were made in France, under the following conditions: 192 pounds boiler pressure, with 69 degrees Fahrenheit of superheat; mean horse-power, 307.8; revolutions per minute, 772. The consumption of steam was 13.92 pounds per effective horse-power.

The first Parsons steam turbine and generator was built in 1884. It developed 10 horse-power at 18,000 revolutions per minute. It ran for several years in Gateshead-on-Tyne, England, supplying current for the manufacture of incandescent lamps. It is now in the South Kensington Museum. It consisted of two groups of 15 turbines each, the steam entering between them and passing in opposite directions through each *group*.

Fig. 8 is a general longitudinal section through a Westinghouse-Parsons steam turbine. The steam enters at the governor valve and arrives at the chamber A, and passes out to the right through the turbine blades, eventually arriving at the exhaust chamber B. The blades are shown in Fig. 15, the steam passing first a set of stationary blades and impinging on the moving blades, driving them around, and so on. The areas of the passages increase progressively in volume, corresponding with the expansion of the steam. They will, however, be described more fully later. On the left of the steam inlet are shown revolving balance pistons C, C and C, one corresponding to each of the cylinders in the turbine, which, according to size, may be one, two, three or four in number. The steam at A presses against the turbine and goes through doing work. It also presses in the reverse direction, but can not pass the piston C; but at the same time the pressure, so far as the steam at A is concerned, is equal and opposite, so that the shaft is not subjected to any end thrust.

The pressure D is equal to that at E by reason of the balance port F, so, similarly, so far as the steam pressure at E is concerned, there is no end thrust. This same fact also applies to G.

The area of the balance pistons is so arranged that no matter what the load may be, or what the steam pressure or exhaust pressure may be, the correct balance is preserved and the shaft has no end thrust whatsoever.

At H is shown a thrust bearing, which, however, has no thrust to take care of, but serves to maintain the correct adjustment of the balance pistons.

The thrust bearing is in two halves, the lower half capable of adjustment in one direction, the upper one in the reverse. The balance pistons never come in mechanical contact with the cylinder, and consequently there is no friction. The thrust bearing has ample surface, and besides is subjected to forced lubrication and does not wear. The adjustments once made always remain good.

There is obviously some leakage past the pistons, but it is found to be very small. Centrifugal force seems to have something to do with keeping down this leakage. The particles endeavoring to escape have to pass radially inwards in going through the small clearance. It is supposed, then, that the rapidly revolving pistons have the effect of throwing outwards the particles with which they come in contact by reason of skin friction, so that the particles being slung outwards tend to oppose the escape of the particles inwards. This theory, however, is somewhat imaginary, but in view of the economy obtained, the leakage can not be very great.

At K is a pipe connecting the back of the balance pistons at L with the exhaust chamber (see Fig. 8) to ensure the pressure at this point, being exactly the same as that of the exhaust.

At J are shown the bearings. They are unique in construction. The bearing proper is a gun metal sleeve, which is prevented from turning by a loose-fitting dowel. Outside of this are three concentric tubes, having a small clearance between them. This clearance fills up with oil and permits a vibration of the inner shell, at the same time restraining same. The shaft, therefore, revolves about its axis of gravity instead of the geometric axis, as would be the case were the bearing of every-day construction. The journal is thus permitted to run slightly eccentric, according as the shaft may be out of balance. This form of bearing in a very remarkable manner performs the functions of de Laval's slender flexible shaft. But in this case the shaft is built as rigidly as possible, so is not liable to crystallization, which would result in eventual rupture.

The bearings have ample surface, are continuously lubricated under pressure, and it has been found in practice that they do not wear. They are surrounded by an outer cast-iron sleeve, in which are fitted keys which may be shimmed up and permit any adjustment of the position of the shaft relative to the cylinder.

At R, Fig. 8, is shown a flexible coupling, by means of which the power of the turbine is transmitted. In small sizes the two shafts have a square cut on the ends, the coupling itself somewhat loosely fitting over these. In larger sizes it is generally a modification of this arrangement.

The governor gear and oil pumps generally receive their motion by means of a worm-wheel, gearing into a worm-cut on the outside of the coupling.

At N is an oil reservoir into which drains all the oil from the bearings. From there it runs into the pump M to be

pumped up to the chamber O, where it forms a static head which gives a continuous pressure of oil to the bearings. The pump is single-acting of the simplest possible construction that will not become deranged. The oil runs in by gravity, so that it is unlikely to fail to continue pumping.

A by-pass valve is provided, shown at P, which admits high-pressure steam by means of port Q to the steam space E. By opening this valve as much as 60 per cent overload may be obtained, and in the case of turbines operating condensing full-load may be obtained should the condenser be at any time inoperative, due to any cause, and the turbine allowed to exhaust into the atmosphere. Naturally, the effect of opening the by-pass valve is to reduce the economy to an extent that will be seen later when discussing economy.

The glands consist of packing rings set in grooves cut in the shaft. The rings press outward and remain stationary. Any form of frictionless packing necessarily leaks a little. In the case of the turbine exhausting into a vacuum a little live steam is admitted between the rings by means of a small reducing valve, so that the leakage consists of a negligible quantity of live steam, instead of air, which would impair the vacuum.

In case of the turbine exhausting against anything above atmospheric pressure, a small ejector is provided, which drains the leakage steam from between the packing rings and allows it to drain through a suitable drain pipe instead of escaping into the engine room.

An electrical plant is being installed in the locomotive works of the Austro-Hungarian State Railroad Works, at Vienna, and will consist of a three-phase, 300-kilowatt generator, direct-coupled to a compound condensing steam engine, the generator making 125 revolutions per minute, at 200 volts tension. For repairs, or other minor work, a 60-horse-power generator has been provided. Forty motors, ranging from one-half to 30 horse-power apiece, will be installed, with a total capacity of 400 horse-power. All the machinery will be driven by electricity and the works lighted by 40 arc and 250 incandescent lamps.

An electric railway is now being promoted by Senor Luis Rouviere, of Barcelona, Spain. If the project goes through, the road will be laid from Lerida to the French frontier and the necessary energy will be generated by means of water-power.

Electrical Engineering in the Florida Agricultural and Mechanical College.

The Florida Agricultural and Mechanical College is situated at Lake City, Fla., and is one of the newer types of industrial colleges that have sprung up of late years in the southern states. The department of physics includes that of applied electricity and is under the charge of Professor J. M. Young. The course is hardly properly called one in electrical engineering, but rather a course in applied electricity. Three hours per week are given to the study of electricity during the last two terms of the senior year, the subject being taken up on the completion of advanced work in physics and following it as a proper continuation. A good understanding of the elements of analytical geometry and the calculus is requisite for the course. Twice a week an afternoon is devoted, as are also two hours on Saturday, to laboratory work. The dynamo laboratory is equipped with three generators and power is supplied to it by a counter shaft and also by a gasoline engine. In connection with this room is a workshop in which students are instructed in the winding of magnets, armatures and other practical exercises, including house-wiring.

Among recent additions to the equipment may be mentioned Rowland D'Arsonval galvanometers, with damper and ballistic coils, Willyoung magnetometer, Kelvin current balance, Siemens electrodynamometers of several capacities, Weston and Whitney portable instruments, three powerful electromagnets of different sizes, Ryan spiral coil voltmeters, Deprez-D'Arsonval dead-beat reflecting galvanometer, Wheatstone bridges of Queen and Willyoung patterns and a complete X-ray plant.

Northwestern Electrical Association.

The ninth annual convention of this association will be held at the Hotel Pfister, Milwaukee, Wis., commencing on Wednesday morning, January 16, 1901. Reports and papers on subjects of special interest to central station men will be read and discussed. The hotels and railroads have made special rates for the occasion, and a large attendance is expected. For rooms, exhibit space, etc., apply to Manager Hotel Pfister; and for wiring, current, etc., for exhibits, to Mr. O. M. Rau, 451 Broadway, Milwaukee. For information as to railroad rates, special train and car arrangements, address Mr. James Wolff, chairman, 320 Dearborn street, Chicago. An attractive entertainment programme has been arranged, and a pleasant and profitable time is assured to all who attend the convention. The association extends a cordial invitation to all electrical men.

PERSONAL.

Mr. Charles A. Tinker, general superintendent of the Western Union Telegraph Company, New York city, has so far recovered from a recent attack of typhoid fever as to be able to go to Atlantic City, N. J., where he will recuperate.

Mr. Frank C. Mason, general superintendent police telegraph, Brooklyn, N. Y., read a paper in Charleston, S. C., before the fire department convention in that city, on December 13. The paper was entitled "The Fire Departments of Our Cities," and was enthusiastically received.

Mr. V. H. Yarnell, who has been identified for many years with the electrical industry, has accepted a connection with Mr. John T. McRoy, the manufacturer of McRoy conduits. Mr. Yarnell will be active in the eastern states and in Pennsylvania, New York and Virginia. Mr. McRoy's New York office is 302 Broadway —the western office is 138 Washington street, Chicago.

Mr. Edwin R. Weeks, ex-president of the National Electric Light Association, and for many years at the head of the electric lighting interest of Kansas City, Mo., has decided to devote himself to electrical engineering and has opened an office in the new Nelson Building, in Kansas City. Mr. Weeks is a man of ability and standing in his profession. The ELECTRICAL REVIEW extends its best wishes for his continued success in the congenial line of work he has decided to follow.

A consolidation of all the railroads in Cuba is said to be planned by the Canadian syndicate whose incorporation was recently noted in the ELECTRICAL REVIEW, and when the plans of the corporation are complete electric power will be substituted for steam throughout the island. Sir William Van Horne has been in Cuba for some time and has already obtained the old Santiago city street railway franchise and the local water and light plants and will substitute in that city a thoroughly modern electric system. Among other cities included in the company's plans are Santa Clara, Puerto Principe, Sancti Spiritus, Cienfuegos, Sagua la Grande, Cardenas, Colon, and many others.

Plans have been received by the Seattle, Wash., electric company for its new central power-station, which will be erected next year at a cost of between $750,000 and $1,000,000. Bids will be received until January 1, and it is stated that a few days after that date the contract will be let.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE CXII—X-RAYS LIGHT APPARATUS FOR PHYSICIANS IN THE COUNTRY AND OTHERS.*

In Figs. 84 and 85 is shown a later form of tube holder. It is provided with a spirit lamp. With this the tube can be made hot before exciting it, a matter of consequence when the initial resistance is high. The cover of the box is hinged, the sliding plate holding the Tesla screen and the diaphragm plate forming part of it. The box takes two as well as three terminal tubes. If, as nearly every one believes, X-light is responsible for the burns, then this is an additional reason for always using an enclosed tube, for in this way the patient and physician are mostly protected from the light. In earlier notes I have said all that seems at present necessary on the subject of tubes and now I wish to consider generators, and the modifications which the commercial ones need to fit them for exciting X-light tubes for use with the fluoroscope, for the future of X-light in medicine lies largely in the results which will be obtained with this instrument. The first requisite is an apparatus which will give a powerful light under perfect control both in quality and intensity. To throw some light on this problem for Dr. Williams, I built the most powerful influence machine which has yet been constructed. This machine, which has 16 plates averaging nearly two metres in diameter, has proved to be a satisfactory apparatus for producing X-light and is the best generator for hospitals where cost and size are not important. Constructing the machine myself the cost ($2,000) was probably greater than that of duplicating it. Messrs Oelling and Heinze believe that this cost could be reduced to about $1,700. The floor space required for the machine is 10 by 6 feet. The height 10 feet. There is no other form of generator at present known that can compare with such a machine in the steadiness of the X-light from a tube excited by it, though I hope a modification of Trowbridge's storage system, which is being constructed for me, will equal it in this respect as it would be more portable and less expensive, but greater attention to the resistance of the tube will be required, see Note xcix. The next most satisfactory generator is a coil which I designed for Dr. Williams. With it can be obtained all the various forms of currents used in electro-therapeutics and called by such odd names as "static induced," "faradic," "franklinic," and others. The coil gives a one-centimetre spark of small capacity, or a 43-centimetre spark of large capacity, or any potential between the two, by simply moving two handles within reach of the physician. This great flexibility in potential and amperage makes the coil useful for exciting X-light tubes, for the light is under control.

* Concluded from page 666.

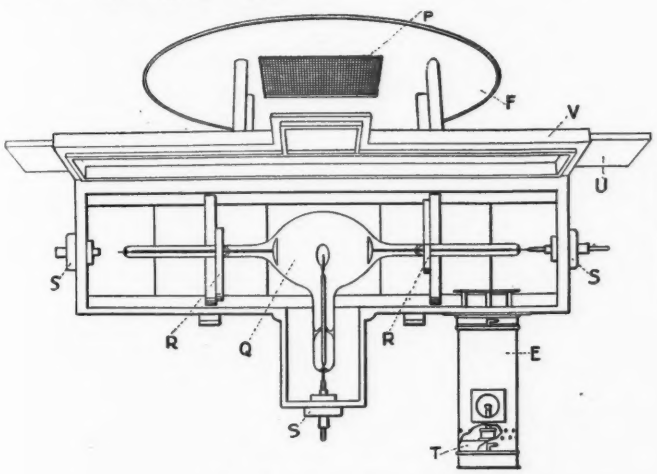


FIG. 84.—TUBE HOLDER.

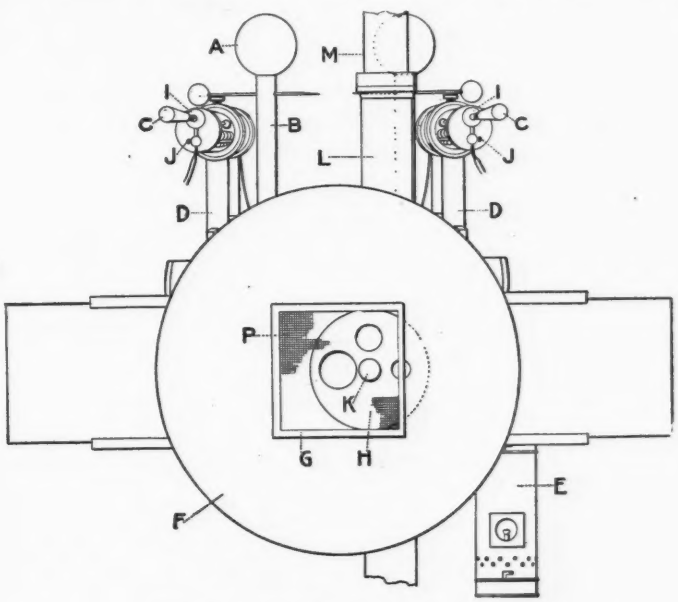


FIG. 85.—FRONT VIEW OF TUBE HOLDER.

A coil of this type is shown in Figs. 86 and 87. The description begins with the primary. By means of two handles attached to this and placed within reach of the physician while making an examination of treating a patient, the output of the coil can be controlled by changing the position of the secondary in the field of ether strain produced by the primary. One handle causes the copper wire of the primary to vary its position in relation to the secondary. The other allows the core to be moved partly out, withdrawn, or another put in its place. Though familiar with similar adjustments in the feeble coils used in therapeutic work, one can not appreciate the importance of these movements on a powerful coil both for X-light and electro-therapeutical purposes, except by actual observation. The material of the tube separating the primary from the secondary is a matter of importance. I desire often to use 1,400 watts in the primary. With a powerful coil the induced current smashes through hard rubber and glass. Mica (micanite) is therefore better.

The method of arranging the sections of the secondary differs from that in other coils. The sections are independent of the tube surrounding the primary. The tube may at any time be withdrawn to remove a section of the secondary. Each section is separated from the next by plates of mica and can be removed by simply drawing out the tube enough to free it. The wires from every seventh pair of sections are brought up to a brass ball in a glass or mica plate extending the length of the coil. By means of the adjusting rods shown in Figs. 86 and 87, any number of sections of the secondary from 7 up to 196 can be used. To vary the amperage with any of these degrees of potential the movements of the primary already mentioned suffice. It is interesting to see the output of the coil reduced by these means from a roaring torrent capable of killing a man, to a little spark hardly felt when the current passes through the body. By removing the caps of the Leyden jars, putting in their places hard rubber rings supporting the high-frequency coil, we get this form of current for therapeutic work, and adapt the coil to a very important future field of electricity in medicine.

With the electrolytic break invented

by Spottiswoode in 1865 and familiar to those who have studied the early literature of vacuum-tube work a large amount of current can be sent through the primary of a coil. As a result the resistance of tubes soon falls, the light in consequence becoming of a character that does not properly illuminate the fluorescent screen. To overcome this a spark gap is used in series with the tube answering the purpose roughly for a time. Then, as the resistance continues to fall, the spark gap must be made longer to keep the character of the light constant. It then becomes so unsteady as to be unsuitable for the fluoroscope. The same difficulty is also encountered with a powerful static machine. To overcome it multiple spark gaps must be used. Consult here Notes xlv and lxxii. I do not know who first used more than two spark gaps in series with an X-light tube. The idea came to me through Mr. Nado Soracio, who used three. I increased the number to 14 on the static machine shown in Fig. 83. For a generator of this size, however, the double and adjustable spark gap shown in my note in the *American X-Ray Journal* for November, 1898, and in Fig. 83 answers, as such an apparatus has neither potential nor amperage enough to use tubes of as low resistance as are desirable to get the best light. Williams applied the idea of many spark gaps to his large static machine. The form he used was shown in the *Scientific American* for June 17, 1899. I applied this construction to the static machine mentioned in Note xxxix, enclosing the spark gaps to prevent noise. When so enclosed the hard rubber took fire and, becoming a good conductor, short circuited the spark gaps. A glass tube was then used, the balls being fastened into holes drilled in the glass. When glass is so drilled it is apt afterward to break. This form was abandoned, the balls being supported by encircling rings. It was efficient but too expensive. The balls were next mounted on strips of mica, the strips being enclosed in boxes of prepared wood. Figs. 97 and 80 were then made of the arrangement, as it appeared to be satisfactory. After a time the spark began to jump to the wood, at length carbonizing it, thus the spark gaps were short circuited. Next the plan shown in Figs. 81, 85, 86, 87 was adopted. It is efficient, cheap, easily applied to any of the usual types of generators in the market. The strips of mica carrying brass balls are enclosed in glass tubes, closed at one end by caps of hard rubber provided with brass balls projecting into the tubes and serving as the terminals for the coil. The other ends of the glass tubes are closed by caps provided with metal sleeves through which pass sliding brass rods terminating at their inner ends in brass balls, at their others in non-conducting handles. The figures (81 and 85) show this arrangement attached to a Ritchie coil. I have selected this coil for illustration because we owe to Ritchie the modern type of induction coil. Page invented the induction coil, developing it from the discoveries of Faraday, Henry, Sturgeon. Ritchie invented the method of winding the primary in sections, which is used by every maker. It was four years after Page's coils were in use before Ruhmkorff made one as good, therefore induction coils if they are to bear the name of any man should have the names of Page and Ritchie. To adapt a Ritchie coil for work with the fluoroscope the ordinary terminals are removed, new supports being attached, which end in sockets into which metal balls of various sizes may be set in order to vary the capacity to suit the requirements of the tube. The multiple spark gaps are supported from the usual hard-rubber ends of the coil by posts of hard rubber terminating in rings of the same material.

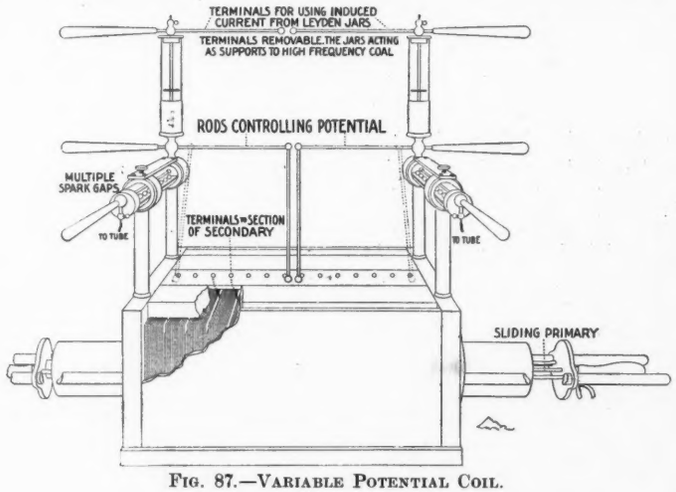

TERMINALS FOR USING INDUCED CURRENT FROM LEYDEN JARS
TERMINALS REMOVABLE. THE JARS ACTING AS SUPPORTS TO HIGH FREQUENCY COAL
RODS CONTROLLING POTENTIAL
MULTIPLE SPARK GAPS
TERMINALS = SECTION OF SECONDARY
TO TUBE
TO TUBE
SLIDING PRIMARY

FIG. 87.—VARIABLE POTENTIAL COIL.

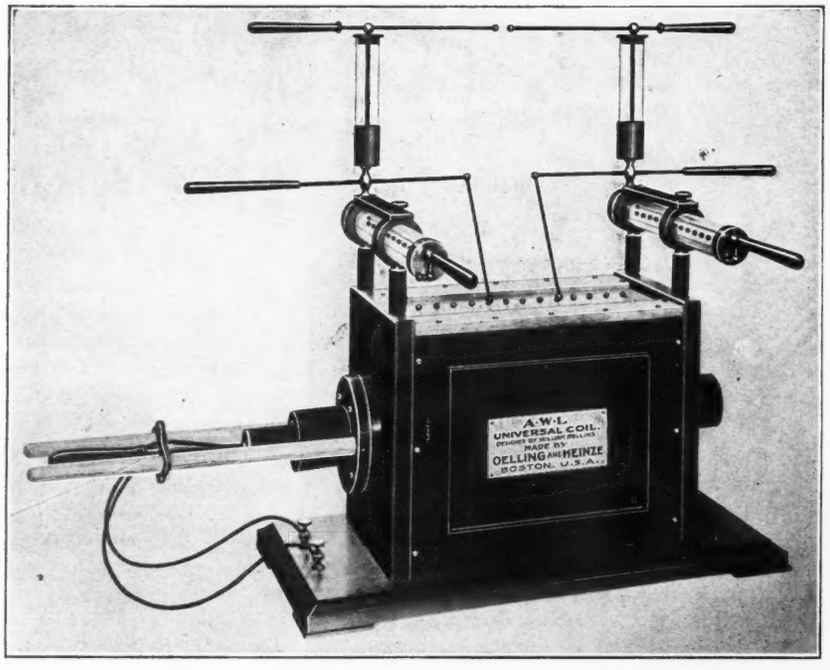


FIG. 86.—UNIVERSAL COIL.

These rings support the glass tubes forming the exterior of the spark gaps. When the brass rods are pushed into the tubes they make contact with the balls forming the terminals of the coil. The current then comes through the rods to the tubes to the flexible connecting wires. One or more spark gaps may at any time be introduced by drawing out the rods. The current must then jump from one ball to another, the number being determined

by the position of the rods. There are many Ritchie coils in use and I hope the owners will apply this form of spark gap to them. Figs. 86 and 87 show the method I have used on my variable-potential coil. The handles controlling the spark gaps are in convenient positions for the physician to operate them, thus controlling the light, without removing his eyes from the fluoroscope. This is a matter of prime importance. It is the custom to think that high potentials are not desirable for

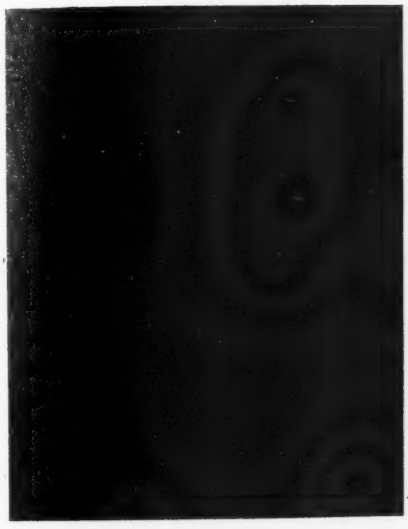


FIG. 88.

X-light, that generators having six-inch sparks are sufficient, because tubes give the best light when they have a resistance of from two to four inches. Nevertheless, there is a great objection to such generators as I have already mentioned in earlier notes. One objection I now repeat. The amount of force sent into a tube to produce a strong light drives many particles into the circulation. The result of this increasing mist through which the cathode stream must force its way to the target to produce X-light is to cause the stream to strike with less force. Less X-light is therefore produced than under more favorable conditions, and finally none can be obtained. The tube must then be repumped or run for many hours until the particles have been driven into the glass, thus raising the resistance to the proper point for producing the light with the least expenditure of force. If the tube is attached to a generator of sufficient potential to allow the use of many spark gaps in series, then the low-resistance tube can be made to give an abundance of light of a beautiful quality for fluoroscopic work or for photography.

This matter is illustrated in Figs. 88 and 89. The subject was a piece of hen. The negative from which Fig. 88 was made had an exposure of 28 minutes with a low-resistance tube and no spark gap. The negative from which Fig. 89 was made was exposed 28 seconds with multiple spark gaps in series. The plates were taken from the same box, exposed at the same distance from the tube, which had remained excited during the interval between the exposures, a period of about two minutes. The tube had been excited continuously for three hours to get it into a fairly constant state. The only change in the conditions was the introduction of spark gaps when the second plate was exposed. The plates were developed together in the same solution for the same time. Though the first had 60 times the exposure of the second, no trace of an image was visible the negative developing as clear glass and therefore printing black as in the figure. The result would have been the same had the exposure been 28 hours instead of minutes, for the tube was giving no X-light without spark gaps. In this connection I wish to state that a tube may not be giving any light visible in the fluoroscope and yet it may be capable of producing an image on a photographic plate, which as well as other experiments, shows how important it is to find new fluorescent substances. No better illustration of the value of high-potential generators should be required than these two pictures.

FIG. 89.

If other proof is needed it may be found in the greater ease with which Dr. Williams has been able to continue his classical work at the Boston City Hospital since my experiments showed to us the importance of high-potential generators and low-resistance tubes (that is, tubes so low as to be considered useless by others), for obtaining a light under perfect control and having the proper quality to markedly differentiate tissues differing but little in density. Refer to Note x, ELECTRICAL REVIEW for January 5, 1898, when the matter was treated from a different point of view.

Some one may ask why not insist upon obtaining from the makers tubes with stable resistances of the degree fitted for low-potential generators. Aside from what has already been said there is another reason. The terminals of such tubes are very dry. The sources of the cathode stream being partly dried up, the use of a regulator to bring fresh gas into the tube is sooner required or the tube must be heated. I like a tube that when run for an hour has no measureable air resistance, meaning by this one with less than a millimetre. With such a tube I have the means of sweeping through a great range in the character of the light by simply moving the spark-gap handles and the potential handles of my coil. In this way bright light may be suddenly evolved from intense darkness. The coil, to which I have given the name A-W-L, applied to the tubes described in earlier notes, was made for me by Oelling & Heinze, to aid Dr. Williams in his work at the Boston City Hospital. For interrupting the current in the primary I use the Heinze break made by the same firm. This is a modification of the Spottiswoode break already referred to. The break has been subjected at intervals to the roughest use in my experiments during the past year. Its general form is evident from Fig. 90. By means of a motor, one or more platinum wires are caused to move in and out through orifices in glass tubes under proper solutions. This is the only electrolytic break which gives a sufficiently steady light for use with the fluoroscope. No break gives quite as steady a light as a powerful static machine, but this one is the best I have used and should have a wide introduction when its merits become known.

FIG. 90.—HEINZE BREAK.

It is announced that private telegrams, "expressed in plain English," may now be accepted for Ottoshoop, Lichtenburg and Zeerust. Imagine being compelled to use plain English to a place called Ottoshoop! —New York *Press*.

Views, News and Interviews

The "electric explosion" noted in San Francisco daily papers as occurring in a building corner Sansome and California streets, was an explosion of gas. Electricity does some queer things, but never "explodes."—*Mining and Scientific Press.*

A pleasant surprise was inaugurated by the Brooklyn Rapid Transit Company, Brooklyn, N. Y., during the recent cold weather in the shape of hot coffee for cold motormen and car employees. A man was stationed at the terminal of each line with a 10-gallon tank of coffee and every time a car arrived the conductor and motorman were given a steaming drink of the grateful refreshment.

A report from Buffalo, N. Y., states that snow-fences are now being erected bv the International Traction Company all along its lines, which heretofore have been at the mercy of the elements during the Winter, especially in rural districts. The snow-plow was in almost daily use last Winter and the experiment was tried of having snow-fences between Buffalo and Niagara Falls with excellent results. This is what has led to their general adoption by the company.

Every one familiar with western literature remembers Bret Harte's "White Cat," the famous animal which ascended on a blast and "riz and riz." Another cat has performed a feat of somewhat similar nature but with different consequences, as one afternoon it jumped into the flywheel of a large refrigerating company's engine, and, as the engineer could not shut off the lights and stop the power of the plant, the animal was compelled to stay where it had gone for two hours and a half. On stopping the engine the cat was found alive, having traveled altogether about 73 miles. "The public mind reposes in the fact that this cat came back to earth, while Harte's cat never did."

Bribing a trolley car conductor is reported to be the newest way of successfully accomplishing an elopement when an irate parent is trying to catch the car and put an end to the proceedings. An occurrence of this nature recently occurred on Long Island. The lovers were on the car and papa came chasing after it at top speed. He was gaining rapidly; the car was slowing down; the young man's fears were rising. With an inspiration worthy of the moment, the young man fished a bill out of his pocket pressed it into the conductor's hand, and he of the punch, who comprehended the situation in an instant, pulled the bell and away shot the car. The young man's father-in-law arrived in time to see the parson give the young people his blessing.

Sterling, Ill., is reported to be considering trolley funeral cars which will be inaugurated by the Illinois & Rock River Electric Company. A trolley hearse will lead the train. The hearse will be jet black with heavy plate-glass sides, built after the conventional style, but shutting the motorman entirely off from the interior of the car. The next car will be painted in black and gold, arranged in compartments. Just how patrons of this novel funeral arrangement will manage to get the coffins of their dead into the hearse in case the tracks for it are not laid past their doors is a matter of surmise, but it is probable that the crafty Illinoisians will manage to solve the problem in some manner. If they do not it will be a curious sight to see a coffin borne through several streets upon the shoulders of men to be at length put into the trolley hearse.

A rather curious method of burglar-catching was resorted to by an ingenious maid servant recently in New York city. While in pursuit of her household duties the maid noticed a man's foot inside the clothes closet. She did not scream, neither did she jump at the door, nor shut it with a bang; instead, she took a broom and began to sweep that corner of the room near the closet. Her approach was gradual and the sweeping was done so naturally that it would not have aroused the most suspicious burglar. At last the broom brushed the door gently but hard enough to close it to the fraction of an inch. With five or six more gentle sweeps that closet door was shut and almost latched, which she at length succeeded in doing by gently pressing her arm against it. As the telephone in her house was so near the closet that the burglar would be able to hear her if she called for assistance, she bethought herself of another plan. In the back yard some telephone linemen were at the time making repairs on a wire that runs to another house in the block. She went out and spoke to them; they promptly tapped a wire, attached a testing instrument and called up one of the downtown exchanges, which in turn got the house owner, who in his turn called up police headquarters. From there the call was sent to the police station nearest the house and two policemen were sent around and got the man.

Automobiles

Another probable revolution in the automobile business is predicted from Millersburg, Ohio, where a local electrician has invented an automobile propelled by a primary battery, into which the electrolyte is fed drop by drop. The inventor is already (so the article says) in receipt of letters from manufacturers of these machines, offering fabulous sums for the sole right to make them. "Mr.—— is a young man," the article continues, and from the way he "fixed" the newspaper reporter, we infer that he is a very "promising" young man.—*Horseless Age.*

The Automobile Club of America has appointed the following committees for the ensuing year: Contests and technical—C. J. Field, chairman, with power to appoint four associates. Laws and ordinances—George F. Chamberlain, chairman; James C. Church and one to be named by the chairman. Runs and tours—Albert C. Bostwick, chairman; Dr. J. Grant Lyman, J. C. McCoy, George Isham Scott, Harrison K. Bird, W. E. Scarritt, J. Dunbar Wright. House committee—Charles P. Doelger, chairman; Malcolm W. Ford, S. T. Davies, Jr., J. M. Hill, Samuel H. Valentine. Library committee—A. R. Shattuck, chairman; E. E. Schwartzkopf, F. W. Tousey. Membership — General George Moore Smith, chairman; Sydnev Dillon Ripley, J. M. Ceballos, V. Everitt Macy. Auditing committee—George W. Young, chairman; J. Talbot Taylor, Warner M. Van Norden. Albany Post Road—J. M. Hill, chairman; Colonel John Jacob Astor, Amzi L. Barber, Alexander Fabbri, Ernest G. Fabbri, S. T. Davis, Jr. Good roads—A. R. Shattuck, chairman; George R. Bidwell. Foreign relations — Clarence G. Dinsmore, chairman; David Wolfe Bishop, J. Dunbar Wright.

It is stated by a railway journal that the electric conduit tramway which formed part of the British Westinghouse Company's exhibit at the Tramways and Light Railways Exhibition in London has been purchased by the London County Council and erected in the council's yard at Camberwell. It will be used for training motormen to drive electric cars, and will enable the council's engineers to carry out certain experiments, while councilors will have an opportunity to see what an electric conduit tramway is like when laid under ordinary conditions. The car shown at the Tramways Exhibition has also been purchased, and the gas engine and generator have been hired until the council's own station shall be available.

AUTOMOBILES AND CITY PAVEMENTS.

BY GEO. E. WALSH.

One of the most important items in every city's budget of expenses is that of street cleaning and repairs. So enormous are these items in a city like New York, where the traffic is constant and heavy, that the street cleaning and repairing departments receive more than their share of public condemnation. The question of keeping the streets and avenues in proper repair is becoming more complicated each year because of the tendency to adopt more generally asphalt or Belgian block pavements. The public demands these pavements in place of the old-time cobblestones, but under present conditions the expense of maintaining asphalt or fine block pavements is growing almost too rapidly.

The paving and cleaning of city streets must always have a direct relationship with the transportation vehicles which use the thoroughfares. Neither Belgian block pavements nor asphalt are suited to heavy trucking. The heavy loads break through and destroy both in a comparatively short time. Incidentally, it may be noted that on some of the principal thoroughfares in New York the attempt is made to regulate traffic by forcing heavy trucks to keep off the asphalt, or, as in the case of the boulevard, to keep on one side nearest the curb. Despite this precaution, however, which, at the best is difficult to enforce, the wear and tear on the smooth asphalt pavements are alarmingly great.

The life of a city pavement varies somewhat according to the traffic it must endure, but under ordinary conditions, asphalt pavement should last 15 years, Belgian trap, 20, and best granite blocks on concrete, 30 years. While these are the periods ordinarily set down, it is a fact that some of the asphalt pavements in New York's busy streets have to be renewed every five and ten years. This has not been due to the neglect of the contractors or to the inferior quality of the materials used. It was due solely to the difficulty of preserving such pavement where the heavy traffic is constant and severe.

The question of the relative cost of preserving the asphalt pavements and of keeping the streets clean is of particular importance just now in view of the undeniable automobile boom. This boom to-day rests not so much upon the manufacture and sale of pleasure vehicles as upon the introduction of the light delivery wagons and the heavy motor trucks. The pleasure automobiles have come to stay, and they have demonstrated their fitness in the last two years; but the commercial vehicle is just beginning to establish its record. Its employment by the leading dry-goods houses in the city and by several of the express companies, testifies to its practical value. Indeed, the heavy electric vehicle for carrying large and heavy loads can be definitely demonstrated in figures to be superior in every way to trucks and other horse wagons. The light delivery electric vehicles have been a part of our city street traffic so long that little interest is now excited by their appearance. But the modern motor truck from two to three tons in weight is something new enough to excite general interest.

It is the difference between the relative wear and tear on the street pavements of these modern trucks and the heavy horse trucks which forms important items of consideration for street departments of our cities. These heavy motor trucks are equipped with hard rubber tires, and with broad, flat ones at that. Their relative destruction to asphalt pavement has been recently tested in a series of experiments which tended to show that the wear and tear was fully 50 per cent less than that caused by an ordinary horse truck with flat iron tires. Naturally the friction caused by the iron-shod horses is entirely eliminated, and this of itself is quite a saving.

In London, where the heavy motor trucks and large "auto" omnibuses have been in constant use for some time similar results have been observed. The London public service or electric cars are gradually taking the place of the old-time "bus," which for generations past has been a feature of London streets. These motor cars carry from 10 to 20 passengers, and they make twice the speed of the horse omnibuses. There are upward of 40 used in London and its suburbs, and they have given such satisfaction that double their number will probably be in operation by another year. But the feature of their public use is noticed in the reports of the city council, which intimates that their saving to the street cleaning and street repairing departments is large enough to warrant the city to recommend their use for all public purposes. Similar motor vehicles for public uses are in operation in Edinburgh, Lincoln and Leicester, where similar reports of their economical use to the city have been made.

New York spends probably more money for her streets than any other city in the world. This expenditure includes the money for repairing and cleaning streets, and for opening and repaving old and new thoroughfares. Most of the streets are paved with cobblestones, granite blocks or ordinary good stone blocks. These have been used in the past because of their durability. But the question of economy comes in now which makes it questionable whether asphalt will not in time displace most of these old-fashioned pavements. The cost of moving a ton of freight or any kind of load over different roads varies so greatly that it is impossible to ignore this factor. Thus to move a ton on a level grade at a speed of three miles an hour it requires a force of 224 pounds on ordinary dirt roads. To move the same load at the same speed over a level street or avenue paved with cobblestones a force of 140 pounds would be required. Again on a road smoothly paved with square-edged cobblestones, carefully put down, a force of only 75 pounds would be required to move the load, and on common macadam 64 pounds, and on very hard smooth macadam 46 pounds. A road laid with finest London stone blocks would still further diminish the amount of force required to something like 36 pounds. The difference between these different surfaces is sufficient to show the immeasurable advantage of the best stone blocks, but when it is shown that a force of only 17 pounds is required to move a similar load over a level grade of asphalt it is pretty evident that this latter is bound to become the pavement of the future. Even on a smooth iron railroad the force required for this work is sometimes as high as 10 and 12 pounds.

Asphalt pavement thus offers advantages in the matter of economy of load-haul that must forever place it at the head of desirable city pavements. The only expense that in any way tends to neutralize this is that of repairing it, especially where the traffic is large and heavy. This item of expense can be materially reduced where motor trucks, with flat, hard rubber tires, are used for heavy vehicles, and the ordinary automobiles for light delivery work and pleasure.

There is the secondary consideration of the cost of operating electric vehicles in city streets that must also be mentioned in this connection. The electric motor trucks and automobiles are absolutely clean, and they leave no debris in the streets. With a city with only horseless vehicles used in its streets, the street cleaning department could almost go out of business. Enough could be saved in the street cleaning and street repairing departments of a city like New York to endow several institutions for public learning. Of course, such an ideal city must be only for the distant future, but when it does come the present wear and tear on city pavements and the accumulation of dirt and filth in the thoroughfares will all naturally be eliminated from the question, or reduced to such a small factor that they will hardly deserve more than ordinary mention. Meanwhile, the steady adoption of the electric vehicles for city use hastens the coming of the time.

Electric Lighting

An electric lighting and railway franchise has recently been granted to Edward P. Burch, of Minneapolis, Minn., by the city council of Everett, Wash.

At a recent meeting of the citizens of Woodstock, Ont., a by-law was passed providing for the purchase and renewal of the present electric light plant for $30,000.

A contract has been signed by the town authorities of St. Paul, Neb., for electric street lighting, and work has been begun on the construction of the electric lighting plant at Madison, in the same state.

The electric plant now in operation in Knightstown, Ind., has been offered to the city for $2,500 by its owners, and it is believed that the city will purchase it and endeavor to conduct a municipal lighting system.

Covington, Ky., recently passed an ordinance providing for a bond issue of $75,000 to construct a municipal electric light plant. The ordinance only awaits the signature of the Mayor to become operative.

A syndicate of Philadelphia and New York capitalists has purchased a site at Wymouth, N. J., on Egg Harbor River, for the purpose of erecting an electric power-house to supply Atlantic County with electricity.

The Waterloo, Iowa, Gas and Electric Light Company has recently passed into the hands of a corporation which is backed by the management of the Key City Gas Company. The incorporation articles of the new concern show $60,000 paid-up capital stock.

Rumor has it that several Richmond, Va., capitalists are agitating the construction and operation of an electric light plant and ice factory with a capacity of 20 tons per day. At the present time Welsbach lights illuminate the streets in outlying districts.

Berlin, N. H., will soon have another electric light and power system, whose energy will be supplied by the Gorham Electric Light and Power Company. Poles are already set for wiring and as soon as the necessary machinery is installed the company will commence business.

A movement for cheaper electric lighting is being agitated by the Commercial Club, of Springfield, Ohio. The present electric light company is paying good dividends on a capital stock of $200,000 and a home company was asked for to compete with the present system in order to effect a more reasonable scale of prices for lighting the city.

Mayor Hayes, of Baltimore, Md., showed the representatives and counsel of the United Electric Light and Power Company that the provision in the ordinance of estimates for an appropriation for lighting the city precluded any possibility of a municipal lighting plant for Druid Hill Park, and the company will not make any further efforts in that direction.

Oskaloosa, Iowa, has granted a franchise to the Oskaloosa Street Railway and Land Company for the erection of an electric light and heating plant, as well as a street car line from Oskaloosa to Beacon. The company is bonded to erect all plants within one year from the date of its charter, and the investments are said to mean improvements to the city valued at $100,000.

Cass Lake, Minn., will probably be lighted by electricity in a few days, and at least not later than New Year's. The village would have been electrically lighted on December 1 had it not been that operations in the factory where the apparatus is being manufactured were unexpectedly delayed. Work is now being rapidly pushed forward and the installation will be complete in a few days.

Citizens of Alabama, Ind., are making a vigorous protest against the proposed establishment of a hot water and electric plant which the Home Heating and Lighting Company proposes to install there. Property owners claim that the plant would seriously affect real estate values, and if the company refuses to consider the protest the board of public works will be asked to reconsider the franchise.

For some time past there has been agitated in Glenville, Ohio, a proposition for the establishment of a municipal lighting plant, but at the last meeting of the town council, a 10-year contract was recommended, by virtue of which the village would purchase the light from a private concern instead of operating its own plant, since the plants in Lakewood and Collinwood have been declared failures.

Important improvements are being made to the electric light plant of Herkimer, N. Y. The present plant has an energy of 250 horse-power and the new boiler, which is shortly to be installed, will have 240 horse-power. This will make possible the entire cutting off of the old 200-horse-power machine in case of accident or repair, and brings the energy of the plant up to 440 horse-power.

A press despatch from Rome, N. Y., states that the Trenton Falls Light, Heat and Power Company will shortly apply to the Rome common council for a franchise in order that it may come there and compete with the local company for the lighting contract. Conditions are believed to be favorable for a new company, as the price paid at the present time for electric lights is considered by the Romans as very high.

The Monongahela Light and Power Company, of Pennsylvania, which had planned to furnish light and power in McKeesport, Braddock and vicinity, has abandoned the idea, as the power required by the Monongahela Street Railway Company taxes the capacity of the plant to its full limit, and it would therefore be more economical and advantageous to use plants located in the various towns where the light and power are required.

The recently destroyed power-house of the City Electric Company, of Kearney, Neb., is soon to be rebuilt and the ruined machinery replaced as soon as possible. The cost of bringing the plant to its original working efficiency will be in the neighborhood of $10,000. As was stated in the ELECTRICAL REVIEW in a previous number the plant referred to was destroyed by a break in the canal which practically wiped it out of existence.

A permit has been issued by Kansas City's (Mo.) chief engineer for the laying of additional mains by the Kansas City Electric Light Company in the alley east of Grand avenue. There has been quite a long fight over the matter and the rival company has promised to continue to keep things lively for the successful corporation as long as possible. Each concern endeavors to delay the other whenever possible, and it is said that the legal points in the case have by no means been exhausted.

South Milwaukee is dark. The mayor and common council have disagreed over the purchase of the South Milwaukee Electric Light and Power Company's plant, and until negotiations are opened that will satisfy the company, fuel will not be purchased and the plant will remain idle. Mayor Mansfield refused to sign the order for the purchase of the plant and it was passed over his veto. The company's officers refused to take any chances and permitted the coal to run out. It is not

known at present how the controversy will end.

The transfer of the stock of the Swift Electric Light Company, of Saginaw, Mich., which, on January 13 last, passed into the hands of the United Electrical Security Company, of Boston, Mass. (which also operates and controls the Bartlett Illuminating Company, of Saginaw), was recorded on November 23. The Swift plant will be operated for some time to come until arrangements can be completed which will enable the Bartlett company to do the entire business, as it has recently obtained contracts for lighting the city for the ensuing five years.

Wall Street and the Electrical Stock Market.

While the week just closed has been a phenomenal one in the history of the stock market, perhaps the most astonishing activity has been in the industrials, interesting particularly to us on account of the extraordinary rise in General Electric stock. It will be noted in the list below that all of the electrical stocks on the New York market made substantial advances, the largest being General Electric while Brooklyn Rapid Transit also made a considerable advance.

On the New York Stock Exchange General Electric closed the week at 195 bid and 195¼ asked, showing a gain of 23¼ points. Metropolitan Street Railway, of New York, closed at 174 bid and 174½ asked, indicating a gain of 5½ points. Brooklyn Rapid Transit closed at 83½ bid and 83¾ asked, showing a gain of 8¼ points for the week. Third Avenue Railroad closed at 117 bid and 118 asked, indicating a gain of 2 points. Manhattan Railway, of New York, closed at 113¼ bid and 113½ asked, indicating a gain of 2½ points for the week.

On the Boston exchange, American Telephone and Telegraph closed at 155 bid and 157 asked, showing a loss of 1½ points. Erie Telephone closed at 100 bid and 102 asked, showing a loss of 1 point for the week.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed the week at 9 bid and 9¼ asked, showing a gain of ⅛ point. Union Traction closed at 36⅛ bid and 36⅜ asked, showing no change for the week.

On the curb, or outside market, in New York, Electric Vehicle closed the week at 17¼ bid and 19 asked, showing a gain of ¾ point. Electric Boat closed at 30 bid and 30¾ asked, indicating a gain of 3½ points for the week. Consolidated Equipment closed the week at 13⅜ bid and 14 asked, showing a gain of 1⅝ points.

Wall street, December 22.

Rhodium Alloys.

A specimen piece of pure rhodium wire, exhibited by Heraeus, of Hanau, at Paris, indicates that this metal has only quite recently been prepared in sufficient quantities to study its metallurgical character, although platinum-rhodium thermo-couples have been used for several years, says *Engineering*. Great attention is now being paid to the nature of alloys, and the rhodium alloys are not less interesting than others. According to Dr. Rössler, of the gold and silver refinery of Frankfurt-on-the-Main, rhodium appears to have been confused with iridium in some cases. We have two groups of platinum metals, the one with a specific gravity of about 12, the other with a gravity of about 22. Rhodium belongs to the first group, iridium to the second. If five milligrammes of rhodium are fused with one gramme of silver, melted in lead, the regulus resulting from cupellation is not as bright as silver, but dim gray. When the grain is dissolved in nitric acid, this gray film disintegrates into fine, glittering scales, which float in the solution. These scales are fine hexagonal crystals of pure rhodium. When more rhodium is applied it is afterwards re-obtained in the amorphous state. There is, therefore, no alloy of rhodium and silver, and rhodium is not soluble in silver, but it is soluble in lead. Iridium behaves similarly. The silver-iridium grain, resulting when the above-mentioned proportions are observed, has the bright color of silver, the much heavier iridium particles are imbedded in the botom of the grain, and when nitric acid is applied as solvent, the iridium is again found crystallized, but the crystals rapidly sink in the solution. Larger proportions of iridium are not dissolved by the silver, and remain amorphous. On continued heating the iridium becomes oxidized. The case is quite different with silver and platinum. These two metals alloy, and when such an alloy, containing only a small proportion of platinum is dissolved in nitric acid, some of the platinum, which is itself insoluble in nitric acid, passes into solution with the excess of silver. Further, the platinum residue proves oxidized, and is then soluble in hydrochloric acid. Thus, an observation of Von der Ropp's is confirmed, and it has in fact been known, that the anode mud, obtained in silver refineries from silver containing both gold and platinum, on the Moebius process, leaves an oxidized platinum residue behind, soluble in hydrochloric acid. Ropp found water, oxygen, and nitrous acid in this residue. The rhodium gold alloy resembles this platinum silver in these respects. It is prepared like the rhodium silver alloy, and dissolves in *aqua regia* with a darker color than gold alone would give. The properties of rhodium are evidently influenced by a large excess of gold. If more rhodium (above five per cent) is forced into the gold, which requires long-continued fusion, the excess of rhodium is afterwards found in beautiful star-shaped or feathery needles, easily distinguished from the gold by their gray color. Gold and rhodium seem to form a real alloy, but it has not been isolated so far. To investigate the question further, Rössler prepared alloys of rhodium with bismuth, tin and antimony. The metals have to be heated above their melting points for some time. Bismuth takes up five per cent maximum of rhodium. When the excess of bismuth is extracted with cold nitric acid, crystals of $Rh\,Bi_4$ remain behind, which are themselves soluble in boiling nitric acid. The same crystals can be prepared by fusing together the respective proportions of the two metals corresponding to that formula, and those crystals are entirely soluble in hot nitric acid; no bismuth can then be extracted with cold acid. An excess of rhodium is afterwards found in the crystallized or in the amorphous state; the amorphous metal had evidently not been taken up by the fused mass.

Lighting Apparatus in England.

Information from Blackpool, England, states that two committees have been recently appointed to deal with electric lighting and street railway matters. Some $250,000 are to be borrowed for the construction and equipment of electric lines already sanctioned, and $64,500 for additional street cars. In commenting upon this statement a New York daily paper adds that the quantity of electrical material and machinery sent from this country to England is larger without exception than that shipped to any other foreign country, not only for home use but for reexportation. In every foreign enterprise of an electrical nature which has been invested with British capital, there has been more or less (and generally more) machinery from the United States. The production and selling price of all electrical equipments for both railways, power stations and lighting plants is said to be less costly in the United States than in England, and while, on account of national pride, not many municipal contracts are given by British authorities to American industries, the British engineers, realizing the importance of combining the best possible service with the least expense, where such a thing is possible, turn the contracts over to American bidders, who have been uniformly successful.

A Victory for the Bell Telephone.

Judge Colt, in the United States Circuit Court, Boston, on December 21, gave a decision in favor of the American Bell Telephone Company in the suit brought by the Western Union Telegraph Company to recover a large sum alleged to be due on a division of rentals and royalties, accruing under the terms of a contract between the two companies, dated November 10, 1879. The case has been in the courts for several years and the sum demanded is said to have been $12,000,000.

Under the contract the defendant, then known as the National Bell Telephone Company, agreed to pay the Western Union 20 per cent of all rentals or royalties received from licenses for telephones in the United States. The Bell company issued licenses to various corporations, and received, in many instances, in addition to the annual rental for telephones, 35 per cent of the capital stock of these corporations. The Western Union held that this stock was "rentals or royalties" within the meaning of the contract and that it was entitled to 20 per cent of the stock and the dividends declared thereon.

The Bell company said that the "rentals or royalties" mentioned in the contract were the standard annual rentals for instruments (less commissions) and nothing more. A Master found in favor of the Bell company and the Western Union's exceptions were overruled by Judge Colt. It is supposed that the case will be appealed and that it will in time reach the United States Supreme Court.

To Light Europe's Cars by Electricity.

Announcement was made last week of the signing of the contract between the Consolidated Railway Electric Lighting and Equipment Company, of this city, and Vickers' Sons & Maxim, of London, whereby the former company's system for car-lighting is to be introduced among the railways of Europe.

Isaac L. Rice, president of the Consolidated company, has been abroad since last July arranging to dispose of the company's foreign rights. He has now made a contract with Vickers' Sons & Maxim covering a period of 25 years, which will give the latter firm a monopoly of the business. The contract, it is said, is most advantageous to the Consolidated company.

Fifteen thousand dollars worth of bonds have been sold by Port Austin, Mich., and the money will be used to put in an electric light and water works.

INTER-RELATIONS BETWEEN ENGINE AND GENERATOR BUILDERS IN CONNECTION WITH ENGINE-TYPE UNITS FOR POWER PURPOSES.*

BY H. C. EBERT.

I have thought this occasion particularly favorable to discuss the relations between the engine and generator manufacturers for the purpose of promoting cooperation and harmony and to prevent causes for disagreement.

Purchasers continue to express a strong preference for direct-connected apparatus, and there is now an extremely large demand for this. It is proposed, therefore, in this paper, to deal specifically with the subject of so-called engine-type electric generating sets. The manifold advantages of the engine-type direct-connected generator unit for power, traction and lighting purposes over the old-style high-speed belted type are so apparent to all of us that I think they need not receive consideration here. The management of the Westinghouse Electric and Manufacturing Company are glad of the opportunity to place before your association some of the points which in its opinion might advantageously be considered jointly by the engine and the generator builders with the object of establishing, if possible, a uniform practice in treating these same complex conditions which arise in getting the two parts of an engine-type unit successfully installed. We have observed that when the consulting mechanical or electrical engineer specifies the size and type of the generator unit to be furnished, he generally designates an engine that in capacity, speed and regulation will closely correspond with the same characteristics of the generator to be provided; but when the selection of an engine to drive a certain size generator is made by the purchaser, or he is coached in his selection by the ordinary generator or engine salesman (and this is oftener the case than one would generally suppose) an engine is invariably secured which in these three most important features does not match the electrical part of the outfit. It is in these latter cases where eventually the engine builders have their difficulties and we also have ours, for the engine and generator are correctly considered by the purchaser as a single unit and the failure of one part to meet his requirements constitutes, from the purchaser's standpoint, and that of his engineer, sufficient grounds to withhold his acceptance and purchase of any part of the unit. Manifestly, this is a hardship to the manufacturer whose apparatus is in all respects what it should be and as represented. Our object and yours should be to minimize the chances of an improper combination of engine and generator, and to this end we will invite correspondence from the engine builders and give close attention in the appropriate departments of our works to any inquiries they may make respecting the electrical or mechanical details of the generator set to be provided, so that perfect calculations may be made for efficiently driving the generator from which ultimate power is to be derived.

The engine and generator specifications must be analagous in so far as capacity, speed and regulation are concerned. It is the general practice of the dynamo builders to give their machines a normal rating, allowing for 25, 50 or 75 per cent overload for certain periods, ranging from 10 minutes to two hours and sometimes longer. This overload capacity, upon which the electric companies' salesmen lay considerable stress, avails the purchaser nothing if the steam end of the unit is inadequate to care for it. Will not your interests, the purchasers' and ours be better conserved if we get together on these features to start off with?

There should be uniformity in rating engines with regard to overload capacity of the generator to be driven. Of course, steam pressures, belting, etc., operate to change the engine capacity, but it would seem there could be greater uniformity than has yet been shown.

The engines for direct or continuous-current-power work should be designed to regulate quickly for sudden changes in the load and the drop in speed from no load to the maximum load, however, should be nearly as straight line as possible. This is absolutely necessary to properly care for the over-compounding of the generator as the load increases. . . . It should be noted that what would be considered an ideal regulation and operation in a direct-current installation would not be satisfactory with alternating-current-power generators. There is no difficulty whatever in running two or more direct-current generators together on the same circuit and dividing the loads equally and maintaining them practically constant on the different machines. However, in running alternators together, particularly at slow or medium speeds, the problem is different. In order that each alternating-current machine shall deliver its proper share of current for the common circuit, the machines must work harmoniously and simultaneously. The fun-

* Abstract of a paper read before the Engine Builders' Association of the United States.

damental requisite being that the electromotive forces or voltages produced by the two or more machines operating in parallel must be equal at all times. If not, then at any instance when the voltage of one machine is lower than that of the others, a current will be sent through it from the other machines; this, of course, not being desirable.

If the engine governors tend to give different speeds, say 500 and 525 revolutions, respectively, then it is evident that when the two alternating-current machines are in parallel, the machine which tends to run at the higher speed will carry all the load until the speed is reduced to 500 revolutions, when the second machine will begin to carry load.

It is essential that the governing of the speeds of the alternating-current machines shall be such that when running at a common speed they shall receive their proper amount of power. As stated heretofore, it is to be observed that engines which govern closely between no load and full load, may not be as well adapted for running alternating-current generators in multiple as other engines in which the regulation is not so close. For example, if one engine runs at no load at 100 revolutions, and drops off one per cent at full load, and a second engine also drops one per cent between no load and full load, but happens to run at a slightly higher speed, say 101 revolutions at no load and 100 revolutions at full load, then it is evident that one engine would carry its full load before the other engine had begun to carry any load. If, on the other hand, the engine drops five per cent in speed, that is, from 100 to 95 and from 101 to 96 revolutions, respectively, then a comparatively small load will reduce the speed of the latter to 100, so that the engines will begin to work together almost instantly the generators are thrown in parallel, the engine which tends to run faster carrying only a slight excess load.

A member of your association suggested that this paper contain something to bring about a discussion of what the engine builders should do and what not, and the best way to avoid disputes and disagreements, presumably between the purchaser, the engine contractor and themselves. There would seem to be no good reason for dissension or disagreement if the engine company to furnish the engine and the electric company to furnish the generator will acquaint each other with the general terms of their contract with the purchaser in so far as those terms relate to the integral parts of the generator and engine combination to be supplied. In taking up correspondence with this object in view we will at once disclose any discrepancy in what we are to furnish conjointly to make a complete unit. Usually the parts which are not clearly covered in either the engine company or the electric company's agreement are of a minor and inexpensive character, but still if no attention or thought is given to them, we find ourselves on the ground with a shortage that will seriously retard the erection work and greatly increase its cost. Up to and including 125-kilowatt engine-type generator, 200 revolutions per minute, we furnish simply the bare machine; that is, the fields and armature, without shaft, shaft key, outboard bearings, bed-plate, steel guide strip and holding-down bolts. When we contract for the entire unit our order to the engine company clearly stipulates the parts just enumerated as not being a portion of the generator and are to be included with the engine. With machines of larger capacity than 125 kilowatts, we supply bed-plate, steel guide strip and holding-down bolts, as usually the larger sizes can not have a common sub-base with the engine. These remarks so far, excepting where they relate to parallel running of alternating-current generators, treat specially with continuous-current 125, 250 or 550-volt generators. Conditions surrounding the combined alternating-current, engine-type unit for power purposes are somewhat different and will be referred to later on.

It is assumed that all the members of the Engine Builders' Association are familiar with the work that the committees on "Standards for Direct-Connected Generating Sets," appointed by the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, have thus far accomplished in the direction of standardization, and it is confidently anticipated that their final reports will lead to some definite and unanimous action along that line. The time has certainly come when steps should be taken to prevent unreasonable requirements, and this standardizing of sizes, speeds, shaft diameters and general dimensions, if strictly adhered to, will undoubtedly be a strong preventive measure. The report of the committee, already published, which was, I believe, but tentative, recommended capacities, speeds and probable shaft sizes for centre and side-crank types of engines from 25 to 250-kilowatt capacity generators, inclusive. It made no definite comments on the subject of armature-spider bore, press fits and the method of keying to shafts. In connection with these questions, I would like to outline here, briefly, Westinghouse Electric and Manufacturing Company's standard practice, with which we have invariably had success. Armature spiders are arranged to receive a shaft amply large for extreme rigidity, so as to eliminate crank action as far as possible, it being absolutely necessary that the armature run perfectly central in the fields, to prevent unbalanced magnetic pulls.

Shafts are figured for both deflection and fibre stress, taking into account the possible unbalanced magnetic pull. In submitting generator drawings to engine builders we call attention to this magnetic action if the armature becomes decentralized, and state on the drawings the amount of magnetic pull which may be expected on the generator. As this unbalanced magnetic pull acts at right angles to the shaft and may be in any direction to the plane of revolution, it should be carefully considered, not only for the shaft diameter, but also for strength of foundation, sub-base and bearing housings. The connection between the outboard bearings and the sub-base should be particularly rigid. One or two instances wherein this magnetic action was not taken into consideration by the engine contractor finally resulted in almost total destruction of both engines and generators.

We make allowance for press fit in the armature, the amount depending largely on the material, or rather the quality of the material in the spider. This is such that the fibre stress per square inch produced by forcing the hub on the shaft is greater than the fibre stress produced by centrifugal force due to the rotation of the armature at maximum running speed. The engine shaft and gauges should be absolute, as a mater of record. It is a simple thing to use pin gauges and they are better for giving close results. We, therefore, supply exact shaft gauges to the engine builder as soon as the shaft diameter is settled. Two short press fits are employed, one at each end of the spider hub. It is our practice to use only a single feather, or parallel key, half in the shaft and half in the hub. This key is furnished by the engine builder and fitted tightly to the shaft sidewise. Between the top of the key and the bottom of hub keyway, there is a clearance of about one-thirty-second of an inch. The feather key admits of easily centreing the armature, acts as a guide in pressing it to position and does not deform the hub as a driving or tapering key tends to do. We supply key gauges at the time shaft gauges are sent to the engine maker.

The foregoing remarks relative to stand-

ardizing apply simply to direct-current generators. With respect to alternating-current, engine-type machines, the case is not so simple. There is not the same demand for uniform standard of alternating-current dynamos, there being fewer builders of this type of apparatus. Usually, also, the generators are of such large size that it is not a requisite requirement to have everything in accordance with a predetermined standard. It would be difficult to even assign standard limiting dimensions since there are usually two types of construction, one in which the field moves at right angles to the shaft, and the other in which it moves parallel to the shaft; this, of course, requiring different engine arrangements, especially in regard to shaft lengths. Consequently, to properly combine an engine-type, alternating-current unit, even of the smaller capacities, the drawings should be taken up in each case and the necessary arrangements made for a successful combination.

In general, I would add that the Westinghouse engine-type generators for both alternating and direct-current-power work can be designed with either of the following characteristics:

1. The generator revolving element may be pressed and keyed on an extension of the engine shaft; the engine builder furnishing the shaft, shaft keys and outboard bearing.

2. The generator may be self-contained and include the shaft, shaft-keys, outboard bearing and a half coupling, flanged for directly connecting to the engine shaft or flywheel.

3. The generator revolving parts may be designed with a flanged extension for directly connecting to the flywheel. The shaft on which this revolving element is pressed and keyed may or may not be a part of the engine shaft

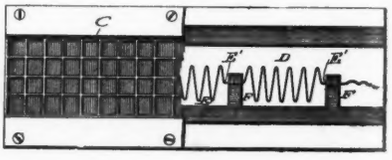
4. The large machines, 850 kilowatts and above, can be built with bosses on the spider arms for directly connecting to an extension on the engine flywheel. In either of these cases the Westinghouse company will provide the necessary gauges and templates to enable the engine manufacturer to arrange his parts for connecting to the generator. Mr. Ebert adding that there was much more to be said on the subject of the relations between the engine builder and the generator builder which would be more clearly and successfully brought out by the general discussion which followed. Mr. Ebert also presented a number of drawings illustrating different types of generator construction on both large and small machines, which were examined with interest by the engine builders present.

The Acetylene Flame.

In a paper published in a recent issue of the *Journal* of the Franklin Institute, Professor E. L. Nicholls gives an account of some interesting experiments on the flame of acetylene. In the first place he states that the illuminating power of the gas falls off enormously if it is kept stored in a gas holder over water for any length of time. In one experiment gas stored in this way for five months gave only six per cent of the light afforded by freshly generated gas consumed at the same pressure and at the same burner. An analysis of the stored gas showed that decomposition had occurred, so that when used only about one-quarter the total bulk was acetylene. The intrinsic brightness of the flame depends also upon the process by which the acetylene is generated. If this is done by dropping water on large masses of calcium carbide, the candle-power of the resultant gas is only about four-fifths as much as when fragments of the carbide are dropped into a large volume of water. Measurements of an ordinary gas flame, and an acetylene flame of equal candle-power, showed that the light-giving area of the former was 12 times that of the latter, and further experiments showed that the number of carbon particles per unit of area was not very different in the two cases. It follows, therefore, that much higher temperatures are reached in the acetylene flame than in the ordinary gas flame, and, in fact, by means of a thermocouple of very fine wire, Professor Nicholls has determined the temperature to be about 1,900 degrees centigrade. This determination is corrected for the loss of heat by the conduction of the leads, and differs much from the estimate of Professor Lewes, whose measures showed the temperature to be lower than that of an ordinary gas flame. This low estimate has, however, been shown to be wrong, since platinum will melt in the flame, and Le Chatelier has on theoretical grounds, fixed the temperature as in excess of 2,000 degrees centigrade. About 10.5 per cent of the total energy radiated from an acetylene flame proves to be in the form of light waves, while with an ordinary gas flame only 2.9 per cent of the energy evolved takes the form of light. Indeed, in this respect, acetylene is superior to the limelight, after the lime has been in use for 10 minutes. Used in the lantern, a four-burner acetylene lamp was inferior to a freshly ignited lime, but better than an old lime. The light given was about four and a half times as great as with a first-class petroleum burner.

Recent Electrical Patents

A simple electric heater has been patented by a resident of Philadelphia, Pa., Mr. John E. Brown, the idea being to provide an article of this character whereby the surrounding portions of the car are not subject to the radiation of heat, and the liability of short-circuiting is prevented. In carrying out the invention, he provides a case which is composed of top, rear and bottom walls that are made of cement or other material that is both non-conducting and fireproof. The front of this chamber is open and is protected by a face plate having openings to permit the passage of the heated air. Within the chamber, or casing, is an electric conductor or rheostat coil which is supported

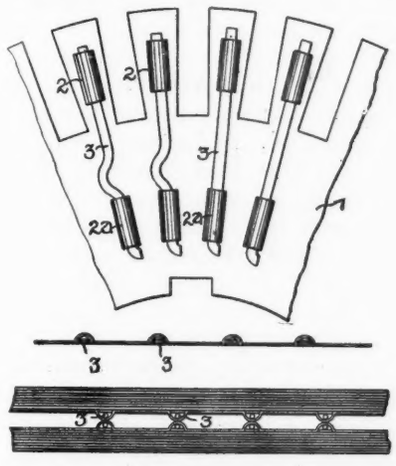


Electric Heater.

from contact with the walls of the same by means of ears that are made integral with and of the same material with which the walls are constructed. It will be noticed that by this construction of casing, the heated air can pass through the same, but that the surrounding woodwork is not directly heated from the chamber, and the burning of the frame and seat can not occur. The rheostat or resistance coil is formed in sections, the adjacent axes being connected by a comparatively straight or uncoiled part, forming reduced necks whereby the coil may be fitted into the chamber at the open front face thereof, and the necks inserted in contact with each other in the open slots of the supporting ears. When it is desired to remove the coil, the face plate need only be disconnected and the coil lifted out of contact with the ears, and withdrawn from the chamber without dismembering the latter, or the necessity of unscrewing nuts, bolts or the like, as none of the latter exists in the construction.

Another late invention in the electrical line is a space block for armatures, or rather an improvement on one already granted to the same inventor, Mr. Henry Geisenhoner, of Schenectady, N. Y., who has assigned the patent to the General Electric Company. In the prior patent, iron strips were secured edge-on to a lam-

ina or core plate of an armature by means integral with the core plate, a number of such devices being placed at intervals in the length of the armature, so as to support adjacent bundles of laminæ, separated by an air space through which the air might circulate. The present invention relates to a similar construction in so far as fastening the spacing strips or pieces to the core plate is concerned, but differs specifically in the manner of attaching them to the core plate. The core plate of sheet iron is provided with a number of radial loops or eyes upset from the body of the plate, into which are inserted spacing strips that are locked in position by suitable means—as, for example, by arranging the strips in position, and then

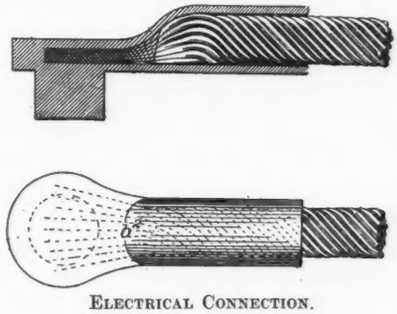


Space Block for Armatures.

bending their heads so as to prevent their radial displacement. An organization of this kind is very cheap to construct, securely anchors the parts in place, and is not easily warped or twisted out of the true alignment by the pressure to which the core is subjected before the armature is finally completed.

A recent improvement in rail bonds consists in the manner of securing the cable to the terminal portion, and is the invention of William B. Cleveland, of Cleveland, Ohio. The terminal portion consists of a tubular arm and a spatulate end united by an intermediate and integral portion which increases in thickness from the end to the tubular arm. The cable which is made in the usual manner enters the end of the tubular arm and passes therethrough, and also through the intermediate portion, wherein the strands are compressed into a flattened form and are more intimately associated with each other and with the terminal. This intimacy of association continues to increase until the cable reaches the spatulate portion of the terminal, where the intimacy is of such a degree as to incorporate the strands and form a homogeneous structure of uniform density. Such a structure may be produced by means of the application of heat and pressure, and the use of suitably formed dies. The incorporated member will thus retain its normal diameter and form at the point of emergence from the tubular arm, so that when the form is of greater flexibility than the terminal, and the latter is rigidly attached to a fixed object, bending occurs at such point of emergence, and in a part of the incorporated conductor of normal condition.

A new arc-light hanger has recently been patented by a resident of Chicago, Mr. George Cutter, the object being to



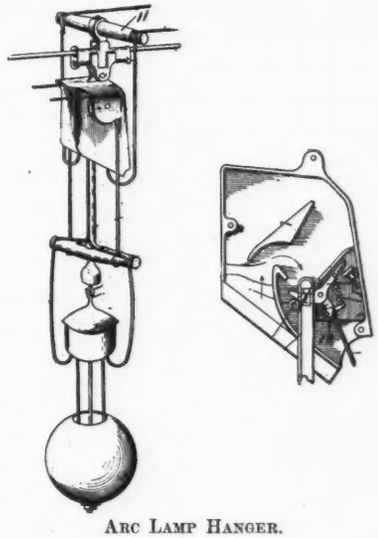
Electrical Connection.

provide a hanger by which an arc lamp can be sustained or suspended in an elevated position, and from which it can be detached and lowered for trimming or other purposes, while the hanger itself remains in its elevated position. Furthermore, when the lamp is lowered, it is automatically cut out of the circuit, and when raised is automatically included therein. In carrying out this invention, the hanger is made of two members, one of which is secured in an elevated position, while the lamp is attached to the other, and is arranged to be raised or lowered by means of suitable ropes. These members have coacting switches which are arranged to interlock when they are in operative relation. The switches of the upper member are connected with the usual feed wires, while those of the lower member are connected to the lamp. When the two members are in coacting relation, the current passes through these switches to the lamp, but when the lamp is lowered, the circuit will be automatically broken. At the same time, the current is short-circuited through the upper member, so as to maintain the line continuously and uninterruptedly.

Plans are to be drawn up by A. G. MacPherson for an electric lighting plant for the United States Government at Fort Sheridan, Ill.

American Bridges Abroad.

The fact that the American Bridge Company has recently opened branch offices in London for the purpose of facilitating the ease and quick handling of its foreign trade is commented upon by an English trade journal, which says in part that the makers of bridges and iron and steel structural work, frequently in connection with electrical enterprises, have been very much exercised recently by American competition, which has been greatly helped by the attitude of the daily press, which frequently printed the grievances of purchasers who are not satisfied with the way that British firms handled their orders. Continuing, the paper states: "We have had the Atbara incident,



Arc Lamp Hanger.

the Gokteik incident and now we hear that American builders have captured the bridge contracts for the Uganda railway in South Africa, the quantity involved being about 8,000 tons. There is no doubt that the Americans do this class of work extraordinarily cheap and we can remember contracts for finished work at less than one penny per pound being signed in America three years ago. 'Made in Germany' seems to have no terrors for the above named company as we observe that it has taken a contract for the erection of shops for the North German Lloyd Company, at Bremen. It is at least satisfactory to find that they do not intend to confine their operations to the one and only free trade country."

The Hartford, Ct., Street Railway Company is said to be contemplating the building and equipping of a track on Franklin avenue in that city. The company is also considering an increase of capital of $3,300 and it is believed that the matter will be ratified.

Telephone and Telegraph

An English report from Egypt states that the cities of Cairo and Alexandria are soon to be connected by a trunk line.

It is stated that the Massachusetts Telephone and Telegraph Company, of Boston, has commenced to furnish its subscribers with a limited local telephone service. Cables are being connected with the company's main switchboard, on Franklin street, and the service is rapidly being extended.

Notices are being sent out by the Michigan Telephone Company to all its Detroit subscribers in the "Grand" district, to the effect that they must give up their old numbers and take new ones in the recently installed for that district. Of the 2,000 numbers connected with the old board only about 900 are still in use, and it is believed by the company that the new numbers will have displaced all the old ones by January 1.

A report from Austin, Tex., states that the strike of the employees of the Southwestern Telephone Company has spread to all first-class cities of the state, the long-distance operators and linemen being out at San Antonio, Houston, Waco, Galveston, Dallas, Fort Worth, Temple and El Paso. Non-union men are being placed in the positions of the strikers as rapidly as possible, but the company is experiencing more trouble than it expected as the long-distance wires at San Antonio have been cut.

Considerable feeling is manifested in San Francisco, Cal., over the claims of the People's Mutual Telephone Company regarding the franchise. A local paper declares that the supervisors will bring suit against the company for the forfeiture of its bonds. Evidence of good faith was never furnished and the company had the franchise extended three times, finally allowing it to lapse. One of the city authorities states that the company owes the city the $10,000 bond it furnished and he will insist upon its collection.

Contracts for a new building for the Maryland Telephone Company, to be erected at the corner of Church Lane and Lovegrove Alley, in Baltimore, have been awarded, and the estimates call for an expenditure of between $22,000 and $30,000. The building will have a frontage of 60 feet and a depth of 108 feet, being nine stories high and the largest of its kind south of New York city. It will be equipped with modern machinery for the manufacture of telephones, and the material used in its construction will be red brick and iron.

Prominent telephone men of Pittsburgh, Pa., have admitted the reported consolidation of the Maryland Telephone and Telegraph Company, of Baltimore; the Delmarvia Telephone Company, of Wilmington, Del.; the United States Telephone and Telegraph Company, which is now building a line from Cleveland to Beaver Falls, and a number of smaller companies. This consolidation will sharpen local and long-distance competition considerably, and put Pittsburgh on a trunk line with the national capital *via* Cleveland, and is considered a combination of interests which will be one of the most important of the independent companies.

Inquiries regarding the local telephone situation in Logansport, Ind., have been received from independent companies at Richmond, Kokomo and Goshen, intimating that they may apply for a franchise. Indianapolis capitalists who are interested in the matter will not have a clear field, as the other companies will probably compete actively in the bidding. It is believed in Logansport that the granting of franchises to competing lines would insure good service, since the rivalry would assure the finest possible equipment of the respective plants and urge on the management of the different companies to hold their subscribers.

A contemporary, devoted exclusively to the telephone field, states that a new ordinance has been introduced by the common council of Kansas City, Mo., by whose terms the telephone rates for business offices are placed at $60 per year and $36 for residences. The article is captioned "What Kansas City Wants from the Bell Company," and continues by saying: "The rates are made higher than those prescribed in the old ordinance in order that no question could be raised in any court as to the reasonableness of the charges. The telephones now in use belong to a class long since discarded. The Bell Telephone Company has wronged Kansas City for a long time."

A number of the high officials of the Central Union Telephone Company held a meeting in Columbus, Ohio, recently, to consider the matter of reduction in price of rentals for their local telephones. There were present at this meeting Messrs. Jackson, Carney, and Richardson, of Chicago, together with the local officials. At the close of the meeting, it was announced that a general reduction in rates would be made. The reduction amounts to from 25 to 50 per cent lower than the rates now in force. It is but the beginning of trouble which has been brewing for some time between the Central Union and the Citizens' Telephone Company. The Central Union also intends to make improvements to its local system that will cost in the neighborhood of $100,000.

The Northern Pacific Railroad has substituted a long-distance telephone system for the present telegraphic communication in use along its lines. This is the first time the system has been put in practical use on a western road, though in the East the Erie has used the telephone for some time past between "blocks" on its signal lines. The plan is to place each station on a division in direct communication with the division headquarters, and the several division headquarters are to be connected with the general offices by long-distance lines. In this way much necessary information of importance to the traffic and operating departments which on acount of the limitations of the telegraph system must now be sent by mail can, in the future, be telephoned at once. The new service is expected to result in a considerable saving and it will be extended so as to do away with the old system wherever practicable.

At the auction of telephone franchises held in St. Petersburg, Russia, on November 20, the United States was unsuccessful in every bid, being represented by the Western Electric Company. The Russian Government proclaimed conditions of rental, and franchises were given to the companies who fixed the lowest subscription. The St. Petersburg municipality obtained a franchise, agreeing to a price of 35 roubles, as against 250 roubles heretofore charged. The subscriptions in other cities were as follows: Odessa, 48 roubles; Riga, 57 roubles; Warsaw, 69 roubles, and Moscow, 79 roubles. Prices for restaurants, hotels and other buildings of a similar character are 30 per cent higher for a single user and 10 to 20 per cent lower for telephones in general use, the custom being to place the instruments in a corridor for the use of the entire building. All the long-distance lines remain governmental property.

The financial statement recently issued by the Mexican Telephone Company for September and the seven months of the year is regarded as the best ever issued by that organization, showing an increase in net earnings of $106.33, from January 1 to September 30, which is but $315 less

than the total net increase of the entire previous fiscal year. The surplus on hand in cash amounts to $265.19 (gold) and the total statement, as given below for the seven months ending September 30, shows the cost of maintenance and construction in Mexican currency. The cash surplus carried over from last year has been expended by the company for new construction and the present surplus amounts to about $22,000 in gold.

	1900	1899	Inc.
7 mos. gross.....	$106,479	$89,552	$16,927
Op. Exp.....	44,816	42,303	2,513
Net.....	46,662	36,029	10,633
Maintenance.....	15,000	11,218	3,782
Construction.....	41,254	19,589	21,665
Deficit.....	9,592	Sur. 5,222	14,814

Employees of the Northwestern telephone exchange in Minneapolis, Minn., recently conducted a successful experiment in wireless telephony at Powder Horn Park. Parallel wires were strung on either side of the lake 600 feet apart for distances of 100 feet, and batteries were placed at their ends, which were grounded by means of a rod run through the ice into the water. Ordinary receivers and transmitters were used, and the conversation, which for the most part was rather indistinct, was considered tolerably successful as occasional words could be made out with entire distinctness, while whistling was faithfully reproduced. For commercial purposes wireless telephony will never be of very much use, although one of the experimenters stated that he believed it possible to carry on conversations on dry land for distances of about 20 miles.

The controversy which for some time past has been so strongly contested between the New York & New Jersey Telephone Company and the South Shore Telephone Company, of Sea Cliff, L. I., continues unabated. The former company has no regular franchise, having come into the town some 15 years ago by permission of the board of trustees and used the poles of the Franklin Electric Illuminating Company. A representative of the South Shore Company went to the electric light company to find out how far the poles already placed might be used. The village woke up one morning to find that the New York & New Jersey Telephone Company was placing new poles on certain streets, and later on it became known that the poles were placed exactly where the new company had planned to put theirs. The corporation counsel has been asked to give an opinion on the matter and in the mean time the people in front of whose premises the poles have been placed are threatening to remove them.

The local telephone system of Lincoln, Neb., has recently adopted a system of supervision over its telephone operators which has been of considerable advantage to subscribers. The change is due to the presence of a young woman on the second floor of the exchange who sits before a machine known as a "joker board," the instrument bringing the supervisor every sound over the whole system, while taking nothing she does or says back to the operators above. For some time the defects in the service have been known, but those in authority found it impossible to get competent operators, and were also unable to ascertain exactly where the operators failed, as they are not always responsible for delays in responding or connections. Under the new regime three seconds is the time allowed for the operator to reply, and downstairs the supervisor holds in her hand a stop-watch, ready set at the even hour. When the valve in front of her flies open at the call of a subscriber, she releases the fly-back on her watch and as promptly stops it with another pressure when the operator responds. If the response is made within the three seconds allowed a percentage of 100 is recorded on the schedule, while for each additional second 10 per cent is deducted. While each one of the operators knows of the supervision and understands the method of marking demerits, no one is able to discover when her turn has come, since, as has already been said, the joker board transmits sound in only one direction. Several things which are forbidden besides cutting off a subscriber before he is through and not repeating the number back distinctly are a "cranky disposition or answer," and the words "hello" and "all right." Why these words are forbidden is not explained, but doubtless some other mode of address is considered more respectful. The operators themselves seem to prefer to be known by some other title than "Hello girls." The system undoubtedly means a great improvement in the service, but the operators "will tread a fearful and rocky road before they reach perfection."

A plant for the recovery of gold by electric dredging processes has been recently installed in Victoria, Australia. The plant consists of a 500-kilowatt, two-phase alternator from which current is transmitted overhead to two barges about half a mile away, each barge containing a 50-horse-power motor and a 150-horse-power motor for its hydraulic pumps. The pumps are driven by the motors through friction clutches and a rope drive.

The British Trans-Pacific Cable.

The Colonial Office announces this week that the Pacific Cable Committee have accepted the tender of the Telegraph Construction and Maintenance Company for the manufacture and laying of the much-discussed Pacific cable. The order is given to this company in the names of her Majesty's Government and the Governments of Canada, New South Wales, Victoria, Queensland, and New Zealand. The amount of the tender sent in by the successful company is £1,795,000, and the company has undertaken to have the work completed by the end of 1902. In view of the great length to be laid, this is a reasonable time, but we should not be surprised to hear that the cable will actually be ready for use considerably before it is due. The route taken by this new all-British cable from Canada to Queensland and New Zealand will be *via* Fanning Island, Fiji, and Norfolk Island. The length from Vancouver to Fanning Island is approximately 3,500 miles, and this section when laid will thus be the longest in the world. The first section to be laid will be that from the Fiji Islands to Australia. The section from Fanning Island to Norfolk Island will be about 1,700 miles, from Norfolk Island to Brisbane, 800 miles, and from Norfolk Island to the coast of New Zealand, 500 miles. The total length of the cable is to be over 7,000 miles. The value of an all-British connection between Australasian Colonies through Canada to Great Britain can not be overestimated in times of peace, and should we unfortunately be engaged in war with any of the Continental powers, the cable may be considered as an absolute necessity. It will be remembered that the present route by which cable messages have to be despatched involves the calling at a number of ports which are not on English territory. Another important consideration is that the cable will be laid in exceedingly deep water, and hence it will be more secure from interruption. It is to be expected that the exact route will be known only to the Pacific Cable Committee, which, again, will seriously increase the labor of the would-be cable-cutter in time of war.—*Electrical Engineer*, London.

Electrical power transmission is said to be giving a new impetus to industries in southern and eastern Europe. At Sinaia, where the Summer palace of the King of Roumania is situated, a fine power-plant has been developed on the river Prabova, where the energy generated is distributed to a number of manufacturing plants in the lower valley of the river.

Electric Railways

Two crosstown lines have been projected in Indianapolis, Ind., one of which will run from White River through Irvington, and the other on Sixteenth street.

Certificates of extension have been filed by the Lakeside, Pa., Railway Company from Delano to Lakeside Park at Tamaqua, and from Shenandoah to St. Nicholas.

The power house of the Wilmington, Del., City Railway Company is to be enlarged and practically doubled in its capacity to meet the increased demands of the company's patrons.

A big trolley line is planned by Indianapolis capitalists to run along the path of the abandoned Erie canal, between Huntington and Logansport. The estimated cost of the road is about $600,000.

A report from Pittsburgh, Pa., states that the new Southern Traction Company, which has secured control of the West End system, will shortly take charge of the property and operate the lines.

An unconfirmed report states that the Schuylkill, Pa., Traction Company is to commence the erection of a very large power station in the Spring, and either Frackville or Maizeville will be the site.

A street railway company which will build a line to run from Parkersburg, W. Va., to Marietta and Williamstown, Ohio, has been organized recently with State Senator Henderson, of West Virginia, as its president.

A report from England states that two additional underground electric railways have been recently projected in London; one from Paddington to Kennington, and the other from Victoria Station to Putney, both being financed by American capital.

A general transfer and interchangeable ticket system has been adopted by street car lines operating within the city limits of Richmond, Va., and although the scheme met with considerable opposition from the officials of one of the companies, the demand of the public was not to be refused.

Contracts have been signed and the New England Electric Railroad Construction Company has begun operations on the new electric road from Burlington to St. Albans Bay, Vt. The company will be known as the St. Albans Street Railway Company and will be running cars, if present expectations are fulfilled, before July 1.

Work has begun on the lines of the Gering & Southern Railroad Company, of Nebraska, whose incorporation is noted in another column. The tracks and grading will be of standard gauge, so that both freight and passenger cars may be transferred to its system from that of the Burlington & Missouri River Railroad, three miles distant.

A franchise has been recently granted at Newport News, Va., to the Hampton Roads Electric Railway Company, which will operate a street railway from that city throughout Hampton Roads to Old Point Comfort, closely skirting the beach at Hampton Roads. Identified with this company is another concern which is said to be preparing to erect a large hotel on Pig Point.

The new trolley cars of the Larchmont, N. Y., electric street railway system, which were delivered on December 1, are the most expensive and best equipped cars in the market. Such strong opposition to the trolley was made by the citizens that the officers of the road felt justified in giving them the best cars that could be purchased. The uniforms of the car men will be of black, with gold-braided, black silk caps.

Ohio's state commissioner of railroads has issued an order which indicates a new policy in the matter of protection at graded railroad crossings. While the order in question applies only to one crossing it is evident that the department has in mind a plan dealing with the subject in its entirety as there are several grade crossings in the state where such traction is very much needed, particularly those in Columbus.

Four separate lines of electric railway have been projected from Toledo, Ohio, to Adrian and other Michigan cities, two of the lines being already under construction. The northwestern part of the state of Ohio is a perfect network of trolley roads, most of which run into Michigan, and when all the roads planned are completed Toledo will be the centre of the greatest electric traction system in the state of Ohio.

The underground trolley system of the Metropolitan Street Railway, of New York city, has been finished on the Broadway, Lexington and Columbus avenue lines, but the cable cars will continue to run all Winter, the trolley not being substituted until Spring. President H. H. Vreeland is authority for the statement that he did not consider it advisable to put the new arrangement to a test during the cold weather.

The newspapers of Brunswick, Ga., while thoroughly in favor of progressive movements in street railway lines for that city, call attention to the terms of the street railway franchise recently granted by the city council, claiming that the franchise is so sweeping that the motive power of the line to be built is not distinctly specified and the company could, if it so desired, run an antediluvian mule line without violating the ordinance.

An electric railway to traverse the Canadian province of Alberta is said to be projected by Ohio capitalists, who desire to provide a short rail, water and freight line to the Klondike and a short rail and water route to the Arctic Ocean. The proposed line will run from Edmonton to Fort Saskatchewan, thence over the Hudson Bay road to Athabasca Landing. From there the route to the Klondike and the Arctic Ocean will be down the Athabasca River to Athabasca Lake, through Great Slave River and Lake to the Mackenzie River, which latter is navigable all the way to the sea.

An experiment in freight carrying by trolley cars in Essex County, N. J., is to be tried by the officials of the South Orange & Maplewood Traction Company between those cities. A tow car of 100 horse-power capacity has been provided to pull coal and freight cars, and sidings are being put in along the route. As was stated in this column recently, the Erie railroad and the traction company are supposed to be planning a combination of which this new freight proposition would seem to be evidence, as it will enable the Erie road to compete with the Lackawanna in the coal business for local points.

The reports recently current in New York city, which persistently affirm that President Rossiter, of the Brooklyn Rapid Transit Company, is to resign, have been denied in the most positive terms, and Mr. Anson R. Flower, one of the directors of the road, stated that there was absolutely no truth in them, giving the reason for the reports as an attempt to influence the value of the stock of the company. President Rossiter has been influential in greatly reducing operating expenses of the road, improving the system and has brought about large economies which have not only made his work appreciated by the directors of his own system, but are favorably commented upon by railroad men all over the country who understand the situation in Brooklyn.

Export Notes

An order has been booked in New York city from the Philippine Islands for a large high-speed engine to drive electric motors, and the firm which has the order on hand believes that it is the first of the sort received from those islands by any American house.

The Azores Islands have fallen into line and our Consul Pickerell, who is stationed at St. Michaels, says that the opening for American manufactures of all sorts is particularly good in the islands, but that as a general rule close prices must be made as cash will be paid on delivery.

It seems from present reports that the entire equipment of the large electric light plant at Kow Loon, China, is to be of American make. As was stated before in these columns, the electrical apparatus, including lamps, dynamos, generators and the other apparatus necessary for the equipment of a thoroughly up to date plant is all to come from the United States and will be shipped in bulk from New York in the near future, one firm having secured the entire order.

A municipal council of Corrientes, Argentina, is considering a proposal to erect an electric power plant, and since most of the electrical apparatus in Argentina is of American manufacture it is believed that the contract for the Corrientes plant will be secured by American engineering firms. Business in Argentina at the present time is in a very prosperous condition and the chances for imports of machinery and tools of all sorts, but particularly in electrical lines, are judged to be very favorable.

A report from Australia states that the 50 miles of horse railway now in operation in Adelaide, New South Wales, are soon to be changed to an electric line, and the Westinghouse company has appeared before Parliament to secure authority for undertaking the work. A bill was recently passed by the South Australian Parliament directing that all the present traction system in the colony should be changed to an electric line as early as possible, and at Sydney the work of changing both steam and horse lines is nearly completed. Here also American enterprise is manifest.

Possibly the most striking feature of our export trade is the magnificent record attained by the manufacturers of electrical machinery and apparatus. Within the last three years the exports in this field, according to the tables prepared by the Treasury Department, have increased from $1,652,656 for the first nine months of 1898 to twice that during the same period in 1899, and to the enormous sum of $3,987,405 between January and September of the current year. Scientific instruments and kindred apparatus, under which classification is included telegraph and telephone apparatus and supplies, show a corresponding increase; the values for the periods named ranging from $2,312,555 in 1898 to $4,849,789 in 1900.

Plans have been prepared for the installation of a lighting plant at Rosario, Argentina, by the River Parana Electric Light and Traction Company, in accordance with the decision of the Arbitration Court at a cost of $475,000. The system of alternating current now in use will be changed to direct current. All the mains in the central streets will be underground and a large quantity of American electrical machinery will be required. The opportunity afforded to American engineers and contractors is among the best of recent years, and it is stated that they will be given the preference over other enterprises even if their prices are somewhat higher, the satisfactory operation and excellent qualities of machines previously installed by American firms having given the enterprise a prestige which no foreign house has yet achieved.

Although the kingdom of Italy is known as one of the leading manufacturing countries in the world for the production of electrical machinery and kindred apparatus, it also supports a very heavy import trade, as an example of which may be cited the fact that during the past week $40,000 worth of electrical machinery has gone from the United States to Genoa, $17,000 worth to Naples and $12,000 worth to Milan. American machinery seems to have the preference over other makes and engineering companies in this country have, at present, orders booked from the principal cities in Italy for numerous large contracts whose aggregate value is more than $170,000. It is confidently stated by persons who are connected with the enterprise that this volume of material is not for re-exportation, as is frequently the case with other European countries, but is for home consumption, thus indicating the strength and prosperity of the electrical industries in that country.

An idea of the value of the French import trade to the electrical and metal manufacturers and dealers in the United States, may be gathered from the fact that $350,000 worth of copper in bar, plate and pig form has recently been shipped to Havre. This may be supplemented with consignments of $36,000 worth of metal working machinery and electrical apparatus to the same port. It is stated by a Paris house that the closing of the Exposition will influence trade favorably and that the tone of the export market will be notably strengthened by heavy and continuous orders. Of all the foreign exhibitors those from the United states produced possibly the best general effect and will derive more actual benefit from the apparatus placed on exposition at the great fair than any others, evidence of this having already been shown in both electrical and mechanical lines, while in the near future, the report says, still greater activity and enterprise will be manifested, and as the feeling in Paris and other large French cities is particularly favorable to American industry and manufacture, it is but fair to expect that our share of the French orders will be large.

Individual exportations and outputs of various large copper mines in United States have so heavily increased that the foreign market for raw and refined copper has been given a steadier and stronger tone during the past year than it has had since 1894, and the prices have been proportionately higher than they ever were before. One large mine alone pays dividends of $8,000,000, or $80 a share on an output of 98,000,624 pounds. Another company on an output of 60,000,000 pounds pays $5,400,000, and other companies show similar increases in their figures. The treasury reports of the United States Bureau of Statistics, Treasury Department, will show for the year 1900 the high-water mark in the history of our foreign commerce. The greatest growth is in raw cotton and manufactured iron and steel, both of which have practically doubled themselves within the past two years. The gross exports of copper for the month of October aggregated $163,093,597, which is practically twice the amount of October, 1894, and the total for the 10 months ending with October is $1,194,775,205, which is again double that of the corresponding period in 1894. With these figures as a basis is it any wonder that other countries, whose export trade has in the past been a very considerable means of their revenue, are viewing the increasing enterprise and growth of our foreign commerce with feelings akin to dismay?

Corporation News

DENVER, COLO. — Modern Machinery and Electrical Company. $25,000.

NEW YORK CITY—F. A. LaRoche Company, to manufacture electrical appliances. $100,000.

HARRISONVILLE, MO.—The Quick Telephone Company has been incorporated for $20,000 by local interests.

KNOXVILLE, TENN.—A temporary receiver has been appointed for the Fountainhead Railroad Company.

NEW YORK CITY—Cremo Incandescent Light Company. $10,000. L. E. Hartley, Lizzie A. Hartley, Joseph Lederer.

INDIANAPOLIS, IND.—Pennville Telephone Company, Pennville; $2,000; A. D. Parks, W. J. Lineback and W. A. Hall.

TRENTON, N. J.—Long Island Electric, Gas and Water Company. $500,000. The incorporators are all Camden capitalists.

HARRISBURG, PA. — Chambersburg & Gettysburg Electric Railway Company. $50,000. John P. Miller, Carlisle, president.

AUSTIN, TEX.—The Corsicana Telephone Company has been capitalized by local interests to operate between Corsicana and San Antonio. Its capital stock is $50,000.

HARRISBURG, PA.—Warren & Sheffield Street Railway Company. $66,000. Incorporators: D. H. Siggins, H. A. Jamison, W. W. Rankin, H. A. Siggins, W. E. Rice, all of Warren.

HARRISBURG, PA.—A Mayfield corporation, known as the Mayfield Electric Light, Heat and Power Company, has been capitalized for $5,000 and will soon commence operations.

STEUBENVILLE, OHIO—The Steubenville Gas and Electric Company and the Steubenville Traction Company have been sold to eastern capitalists, the deal involving about $250,000.

ALBANY, N. Y.—Independent Union Telephone Company, of Buffalo. $200,000. Samuel B. Rawson, Irving H. Griswold, A. E. Lord, Elyria, Ohio; G. H. Frost, Buffalo, and A. R. Smith, North Tonawanda.

JOHNSTOWN, PA.—Cambria Terminal Railroad Company. $70,000. Powell Stackhouse, Wallingford; J. W. Bacon, Philadelphia; J. W. Townsend, Bryn Mawr; A. P. Robinson, Philadelphia; C. L. Price and H. L. Endsley, Johnstown.

MILWAUKEE, WIS.—An increase of $12,000,000 has been made to the capital stock of the Milwaukee Street Railway Company and will be used in general improvements and will build a new powerhouse. The figures now reach $15,000,000.

HARRISBURG, PA.—Carnegie, McDonald & Canonsburg Street Railway Company. $120,000. Incorporators: E. McDonald, of McDonald; R. J. Storey, of Pittsburgh; R. J. Murray, of Sewickley; J. W. Nesbit, W. J. Cassidy, both of Oakdale.

TARRYTOWN, N. Y.—If reliance may be placed in current reports, the agitation for a company to run 35-knot boats between Nyack, Tarrytown, Dobbs Ferry, Yonkers and New York, will materialize in a corporation whose capital stock will be $850,000.

SPRINGFIELD, MASS.—An electric street railway is being projected in this city, which will be organized with a capital of $600,000, and intends to ask for franchises for 20 miles of track. A uniform fare of three cents for a two-mile limit will be established if the project goes through.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company (new corporation) has voted an issue of $3,500,000 in 50-year five per cent bonds, half of which will be devoted to indemnifying present bond issues and the remainder used to extend and improve the company's lines.

OCEAN CITY, N. J.—The Ocean City Association has sold its electric railroad, which runs the entire length of that city, seven miles, to Henry D. Moore for $125,000. Mr. Moore is a Haddonfield, N. J., capitalist and will endeavor to run his cars on Sunday, a thing which has never before been done by the road.

ALBANY, N. Y. — The Amsterdam Street Railway Company has certified to a change of its principal office to Amsterdam from New York city, and the Oneonta & Otego Railroad Company has certified to a change of its name. It will hereafter be known as the Cooperstown & Richfield Springs Railroad Company.

COVINGTON, KY.—The Suburban Electric Company has been sold at public vendue to a syndicate of eastern bondholders for $181,000. It is believed that the Edison Electric Company of Cincinnati is behind the purchase, but this is without confirmation to date. Burgett Loomis is at the head of the purchasing organization.

COLUMBUS, OHIO—A new corporation is the Sandusky, Norwalk & Southern Railway Company, an outgrowth of the Sandusky, Milan & Norwalk Railway Company. The capital stock of the new road is $400,000. It will be extended from its present terminus at Norwalk to Mansfield, carrying on a regular railroad business of passengers, freight and mail.

HARRISBURG, PA.—Easton, Tatamy & Bangor Electric Street Railway. $60,000. Incorporators: Cotton Amy and H. C. Brittain, East Bangor; H. H. Haines, T. A. H. Hay, C. L. Hemingway and W. O. Hay, of Easton; M. P. McGrath, Worcester, Mass., and J. W. Jones, W. R. Grubb, Milton Flory and David Huddleson, of Bangor.

PORTSMOUTH, N. H.—The Portsmouth Gas, Electric Light and Power Company has been sold complete to W. D. Lovell, managing director of the Exeter, Hampden & Amesbury Street Railway Company, for the Rockingham Light and Power Company. The purchase price was not named, but $350,000 will be expended in improvements.

COLUMBUS, OHIO—Chagrin Falls Telephone Company; $150,000. Freeport Home Telephone Company; $5,000. Ft. Wayne, Dayton & Cincinnati Traction Company; $20,000. Incorporators: Samuel F. George, Charles W. Gethart, Clifford E. Swayne, Charles A. Swain, David S. Waymin, E. J. Mounstiphen, A. J. Miller, Davis W. Sinks and William Hoblit.

PORTLAND, ME.—The Portland & Yarmouth Electric Railroad Company has passed into the hands of individual members of the Portland Railroad Company, and General Manager Newman, of the latter corporation has assumed the management of the Yarmouth road. The gentlemen concerned in the purchase are W. R. Wood, C. F. Libby, W. G. Davis, W. A. Wheeler, C. S. Forbes, J. S. Ricker and A. Whitney, all directors of the Portland Street Railway Company.

CHICAGO, ILL.—Citizens' Electric Light, Gas, Heat and Power Company, Danville; $100,000; William V. Tobey, George L. Barney and Charles M. Lewis. F. L. Smith Electric Company, Harvard; $10,000; F. L. Smith, Eugene B. Smith and Leslie H. Smith. Edison College of Electrotherapeutics; $2,500; Percival Steele, F. V. Ohl and M. W. Boernsch. Monarch Mutual Light Company; name changed to Wells Manufacturing Company, capital decreased from $250,000 to $25,000.

KANSAS CITY, MO.—The Kansas City Subway Company is soon to be merged in the Interstate Electrical Subway Company, which will be incorporated for $200,000. Among the directors of the new concern are W. S. Woods and W. A. Rule. In connection with the new concern a telephone company with $300,000 capital and an electric lighting plant with a stock of $500,000 have been incorporated. The new concern will establish a telephone exchange and furnish light and power as well.

NATCHEZ, MISS.—The incorporation of the Natchez Electric Street Railway and Power Company, noted in the ELECTRICAL REVIEW in a previous issue, is of interest, as the capital furnished for the enterprise is stated to be entirely local. The incorporators of the road are A. G. Campbell, T. Otis Baker, J. O. Bailey, Oliver N. Wilds, Ernst H. Jackson, E. A. Enochs, P. W. Mulvihill, S. McDowell, James G. Smith, Theodore Crothers, James W. Lambert, Wilmer H. Shields, John F. Jenkins, Henry Frank, Thomas Reber, E. H. Ratcliff.

Wireless Telegraphy Between England and Belgium.

United States Consul George W. Roosevelt sends the following report from Brussels, Belgium:

There has been recently established at La Panne, Belgium, a station for the exchange of wireless telegraphic messages between Belgium and England. The receiving apparatus to be used on the English coast was taken across a few days ago from Ostend on board the Dover-Ostend mail boat, Princess Clementine, which is also fitted up with temporary apparatus to be used in the experimental trials. La Panne has been selected on account of its being the point on the Belgian littoral nearest the English coast. The mast of the Marconi station at La Panne is 130 feet high. To the foremast of the steamship Princess Clementine is affixed an additional mast, which increases its original height about 60 feet. From this extremity the telegraphic waves will be projected toward each coast. A special room has been fitted up on board the steamer for the instruments, and from this room the cable will be carried to the top of the extended mast. It is confidently expected to obtain communication between ship and shore for at least 30 miles, which is about half way across. With stations at La Panne and Dover, those on board the vessel would be able to keep in touch with the land during the entire crossing.

On November 3, experiments began about 5 P. M. Telegrams were exchanged between the boat, then moored at the Ostende wharf, and the station at La Panne. Later in the evening, several of the Marconi men went on board the vessel and communicated with the land station throughout the crossing, except when they arrived in English waters. Communication was then discontinued, as the Belgian Government has not yet received from the English Government authority to telegraph from Dover by this new system. This week—probably Wednesday or Friday—the official trial under the supervision of the Government delegates will be made.

The experiments showed that replies arrived with the same regularity and celerity as ordinary telegrams. When about 40 miles from Ostend, the captain of the vessel was able to telegraph to the station-master at Ostend the probable hour of his arrival. Various telegrams were sent from the vessel to Ostend, Brussels, Dover, London, and to the officers of the chief bureau and branch offices of the Marconi Company. The reception of each message was acknowledged promptly, the first and last letters being given in each instance. Subsequently a message was sent from the Princess Clementine to the station at Dover Court, Essex, a distance of nearly 90 miles, including many miles of cliffs and sea.

Wireless Telegraph Service for Lighthouses.

A report from Washington, D. C., states that the Lighthouse Board is making an effort to secure an appropriation to equip several lightships and lighthouses with wireless telegraphy or telephony. The board believes that the success of the system has been so fully demonstrated as to indicate that it would be invaluable in communication between lightships and the shore, resulting sometimes in the saving of life. It is proposed to introduce the system gradually, and an appropriation of $25,000 is wanted for a beginning.

Polyphase Electric Distribution in London.

A new substation at Manchester Square, London, England, is being equipped by the Metropolitan Electric Supply Company, which is slowly converting the whole of its system to continuous current. Two polyphase motor generators, which will convert the high-potential alternating current received from Willesden to a low-pressure direct current for distribution to consumers, are being installed. Six motor generator units of 500 kilowatts each will be put in, each machine consisting of a synchronous two-phase motor of 900 brake horse-power, direct coupled to multipolar direct-current generators of the same capacity. Beside the large units there will be three smaller ones of 70 to 80 kilowatts each which will act as exciters, and also to assist in carrying the day load. The installation is one of considerable interest not only on account of its size but because of the special precautions which have been taken on account of the length of the transmission line, and the nature of the generating units in the distant power-station. The generators will be fed from the Willesden power-house, about five and a half miles away, where Westinghouse generators furnish two-phase current at 500 volts per phase, which is raised to about 10,000 volts per phase for the lines. At Manchester Square this will be stepped down to 1,000 volts.

What is considered a remarkable pumping installation is being operated by electricity from transmission lines near the town of Exeter, Tulare County, Cal.

Electric Sheep-Feeding.

A novel invention is now being tried out by Michigan farmers for feeding their sheep, at the Agricultural Experiment Station, Lansing, Mich. A man by the name of McNair has invented the apparatus, taking into consideration the fact that almost all towns of any size have electric generating plants. His invention consists of a curious pen about 15 feet square, built of wire and mounted on flat, broad wheels, being designed to run in any pasture, whether hilly or flat. Wires are run from the pen to the small motor which is stationed at one end of the pasture, this in turn being connected with the feed wires from which the power is derived. When the button is pressed the pen moves slowly across the field.

During the recent tests two lambs and an old ewe were pastured in the pen during the Summer. The field in which the pen was placed had been planted with lucerne, which grew thickly and proved an excellent feeding ground for the animals. The pen is so arranged that it crawls the full length of the pasture in one month, traveling about two feet an hour, at the end of which it is switched around and travels back again. As it moves the sheep eat all the fodder, cropping as a rule at the forward end of the pen as it runs over new ground. In order that the animals may be well sheltered one corner of the pen is covered with canvas duck and the statement is made that so accustomed have they become to the moving of the pen that when they lie down to sleep they choose the forward end in order that they may not be disturbed by the rear end of the pen as it creeps toward them.

The advantages of the invention are stated to be considerable in that it prohibits the sheep from running over, half eating and trampling down a large amount of pasture, while at the same time it keeps them from taking too much exercise, and they gain flesh rapidly. One of its disadvantages is the fact that water must be carried to them daily and the electricity is still somewhat expensive.

The same inventor is said to have produced a mechanism, by means of which the sleepy farmer may push a button on getting out of bed in the morning, which electrically feeds all his horses.

In the same connection we may possibly imagine the farmer of the next century calmly sitting on the porch, dressed in his "Sunday-go-to-meeting" clothes, his feet on the balustrade, a fat cigar in his mouth, and conducting his planting, pig feeding, sheep raising, chicken killing and weeding by pressing the series of silver-mounted, pearl electric push-buttons opposite him.

Industrial Notes

Mr. C. E. WOODS, Chicago, has returned to the manufacture of automobiles and will send his handsome new catalogue to any one interested in the art.

A LARGE ORDER has just been closed with the Sprague Electric Company for 20-horse-power motors of the slow-speed, direct-connected type to operate the new plant of the Delaware Button Company, at Wilmington, Del.

THE AMERICAN BRIDGE COMPANY has a contract for furnishing over 700 tons of structural steel to go to the New York navy yard naval powder depot, near Dover, N. J., and to the naval magazine, at Iona Island, N. Y.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has been awarded recently an order for a 200-kilowatt belted generator for the Laclede Gas Company, St. Louis, and two large orders of note from Philadelphia and New York.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has recently been awarded several orders for the Moloney transformers, for which there has been, it is said, strenuous competition by several of the transformer manufacturers.

OPERATORS of alternating-current plants should read a little book issued by the Electric Appliance Company, Chicago, Ill., and mailed free on request. It is entitled "Skepticism," and is written especially for alternating-current skeptics.

THE OHIO ELECTRIC WORKS, Cleveland, Ohio, is selling large quantities of its electric novelties and supplies. These novelties are all manufactured for practical use, and make an instructive as well as pleasing Christmas present.

MR. H. L. SHIPPY, treasurer of the John A. Roebling's Sons Company, New York, is favoring his many friends with an attractive and useful holiday remembrance in the form of a pocket memorandum book and diary handsomely encased in Russia leather.

"SCAPA" is a society which has done good work in England by devoting itself to the prevention of disfiguring advertising, particularly in landscapes. The work is spreading to this country, and it will be fully described in the January *Scribner's*, by Arthur Reed Kimball.

THE NEW YORK & OHIO COMPANY, Warren, Ohio, well known as the manufacturer of the Packard incandescent lamps and transformers, is winning fresh laurels by the production of a hydrocarbon automobile, which has received encomiums from prominent experts.

IT IS EVIDENT from the large number of orders recently received that the trade appreciates the large stock of Edison plug cutouts of all sizes which the Western Electric Company is carrying in Chicago. Immediate shipment can be made of any style and at attractive prices.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has designed several new types of alternating-current desk and bracket fans, and one new type of alternating-current ceiling fan. These are expected to combine advantages not found in similar apparatus now on the market.

THE WARREN ELECTRIC AND SPECIALTY COMPANY, Warren, Ohio, manufacturer of Peerless incandescent lamps, reports that the Fall business is exceeding all expectations. While a busy period is expected at this time of the year, the present season is unparalleled in the history of the company.

BRILL *vs.* PECKHAM—Judge Lacombe, of the United States circuit court, New York, has granted an injunction in favor of the J. G. Brill Company, Philadelphia, against the Peckham Truck and Motor Company, restraining the latter company from manufacturing the four-wheel trucks with elliptic and spiral springs.

THE HOMER COMMUTATOR COMPANY, Cleveland, Ohio, is now occupying the new building which it has constructed, and with its enlarged facilities and new mechanical equipment, the company is in better shape than ever for the care of its work. The company both manufactures and repairs commutators of all types.

THE SIEGRIST LUBRICATOR COMPANY, St. Louis, Mo., maker of the Siegrist automatic oiling system, which is being widely adopted by electric power-stations, is soon to equip a new factory in St. Louis, and open a New York branch. The success of this oiling system has been such that these moves of expansion are necessitated.

PETTINGILL & COMPANY, Boston and New York, advertising agents, have just published an artistic little brochure, with flexible cover, entitled "The Science of Advertising." For those who are particularly interested in this subject this little volume has many pertinent suggestions. This advertising agency is one of the pioneers in the field.

THE H. B. CAMP COMPANY, Akron, Ohio, manufacturer of the Camp vitrified clay conduits, speaks of the excellent promises for construction work in the Spring, as indicated by the large number of inquiries the company is having for its product. The Camp conduit is made of Ohio vitrified clay, for telephone, telegraph and electric light wires.

CROCKER-WHEELER COMPANY, Ampere, N. J., advises that it has recently received several heavy orders for generators for lighting purposes, a 300-kilowatt railway generator and other apparatus of a similar nature; besides which 66 motors for power work at the Philadelphia mint have been ordered, and 35 motors, aggregating 400 horse-power, for the Toledo Bridge Company.

THE ECONOMY ELECTRIC COMPANY, Warren, Ohio, makes a specialty of renewing burned-out incandescent lamps. This plant is equipped throughout with the latest modern appliances used in lamp manufacture and its product is said to possess unusual merit. Although this company has been in existence less than six months its business shows a remarkable growth and is fully up to factory capacity.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is sending out a neat pamphlet illustrating its core-type transformers for three-wire secondary service. The book is illustrated and contains full descriptions of the transformers. It will be mailed to any engineers or other interested parties upon application to the company, and is a good example of the work of the company's publishing department.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, has removed its San Francisco offices to 593 Mission street, where it has secured greatly improved facilities for conducting its rapidly growing business in that territory, and where its customers will always receive prompt attention. Mr. Clark, who is in charge of the San Francisco office, will take pleasure in showing and demonstrating the merits of any Wagner apparatus he may have in stock.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, is now operating its enlarged factory with increased facilities to its fullest capacity. In a recent interview by a representative of this journal with the officers of this company, it was evident that the new type of Shelby lamps is meeting with the endorsement of many of the highest scientists throughout the world. This company is just issuing a new pamphlet relative to light distribution as embodied in the Shelby lamps.

THE HART MANUFACTURING COMPANY, of Hartford, Ct., is manufacturing push switches which are designed in a self-contained wall case. This case is intended for use in old walls and woodwork of buildings, and in all places where suitable receptacles for switches had not been provided in the original construction. The cases are made of rolled cold steel, with openings in the bottom for wires or flexible conduits. They are very neat in appearance and are easily installed.

THE WESTINGHOUSE COMPANIES' PUBLISHING DEPARTMENT, Pittsburgh, Pa., has issued a very attractive booklet, entitled "Motor-Driven Duplex Air Compressors." These machines are built by the Westinghouse Air Brake Company. Tables giving full particulars of the machines are contained in the book as well as many illustrations, both of the machines, motors and wiring. The pamphlet is bound in green and stamped in slate, dark green and red, presenting a very attractive appearance.

THE CENTRAL TELEPHONE AND ELECTRIC COMPANY, 909 Market street, St. Louis, Mo., has issued recently two new catalogues of interest to telephone users. One catalogue, well illustrated with careful half-tone engravings, shows eight or ten types of standard exchange, long-distance and intercommunicating sets of most modern pattern, several artistic desk sets, test telephones and switchboards of various types. The other catalogue, known as "No. 8," fully illustrates and describes all the elements used in telephone construction work, and the various accessories for operation. These two catalogues will be sent free on application.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago and New York, has issued a booklet showing the character and peculiarities of fuses, fuse blocks, lightning arresters and other specialties, as made in this company's shops. The booklet contains considerable data of interest to operating electricians. In maintaining the New York branch, it is the purpose of the management of this company to carry in stock a complete line of its products for the better facility in pleasing its eastern trade by prompt shipments.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., manufacturer of electric controlling devices and rheostatic apparatus, is said to be filling 85 per cent of the American demands for its equipment at the present moment. A list of its patrons represents a large portion of the dynamo and motor manufacturers of America. This company, it will be remembered, recently absorbed the Ironclad Resistance Company, of Westfield, N. J., and, in addition to its Milwaukee plant, is operating the Westfield plant and maintaining a branch office in New York.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., is sending out a special coin card to be used by engineers and others desiring to examine its instruction papers and text-books. The card contains a place where a silver 25-cent piece may be inserted and securely sealed. This card contains also a place for the name and address and the text-book wanted. It may be placed in an envelope and addressed to the school without further trouble. Any one wishing to examine any of the instruction papers of this school should send for one of these cards in order to send the money safely.

DOUBLE EXPORT AND DOMESTIC NUMBER

ELECTRICAL REVIEW

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is our idea of a correct Alternating Wattmeter, both in theory and practice. We are willing to guarantee them. : :
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Only Fire Detective Wire in the World
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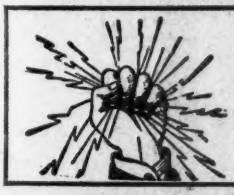
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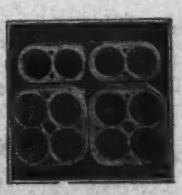
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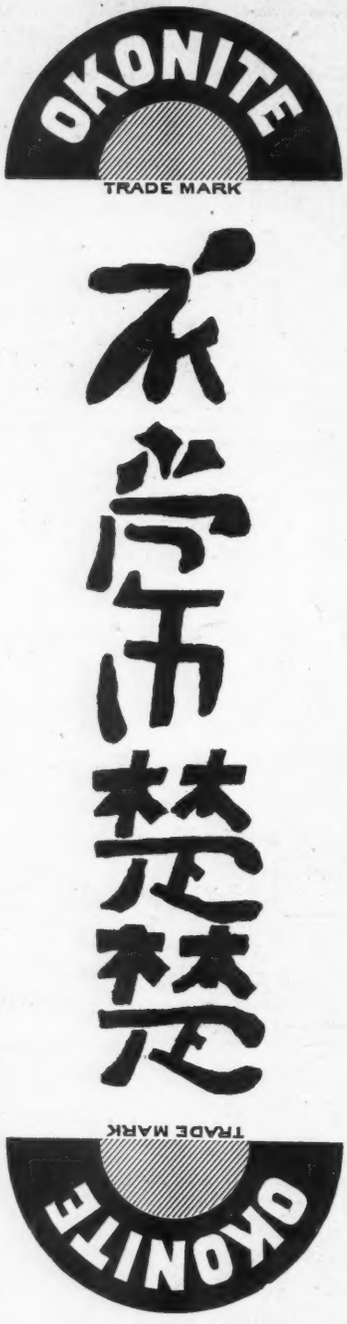

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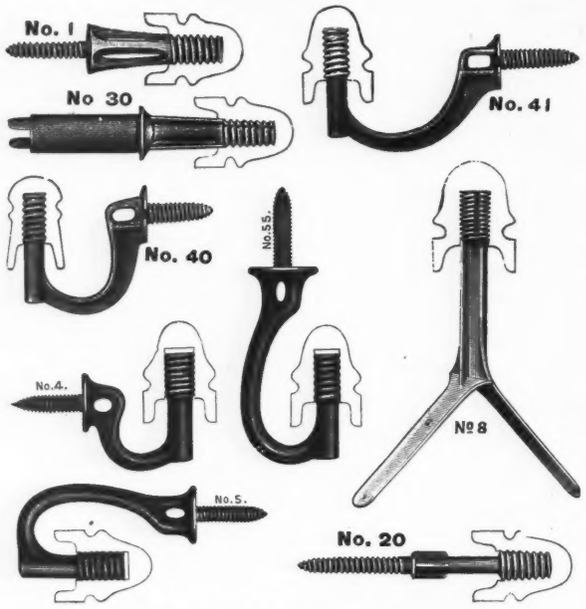

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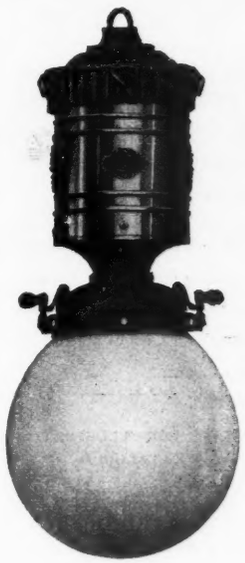

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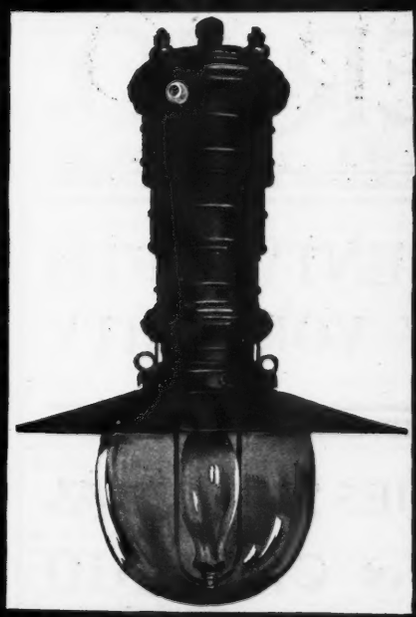

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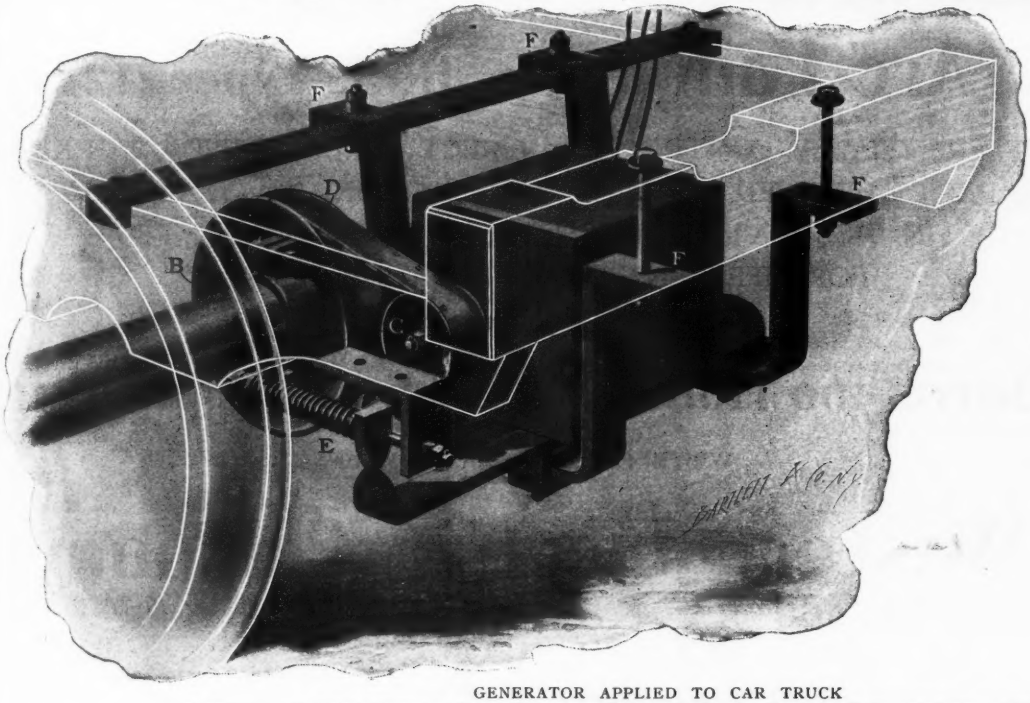

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For the past two months we have been using the alternating current motor sent us by you. It is giving us no trouble, and is doing its work perfectly, at all times.

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Very truly yours,

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Our Self-starting Single Phase A. C. MOTORS

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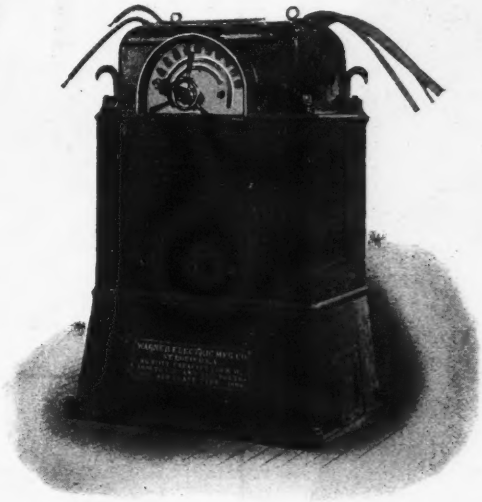
Send for Bulletins "V" 24, 26, 32 and 35.

YEARS OF EXPERIENCE have enabled us to place on the market TRANSFORMERS that can be thoroughly relied upon. They embody the HIGHEST DEGREE OF ECONOMY.



250 K. W. AIR BLAST TRANSFORMER.
Send for Bulletins "V 9, 12, 16, 18 and 33," descriptive of the different types we build.

The CORE LOSS reduced to a minimum.

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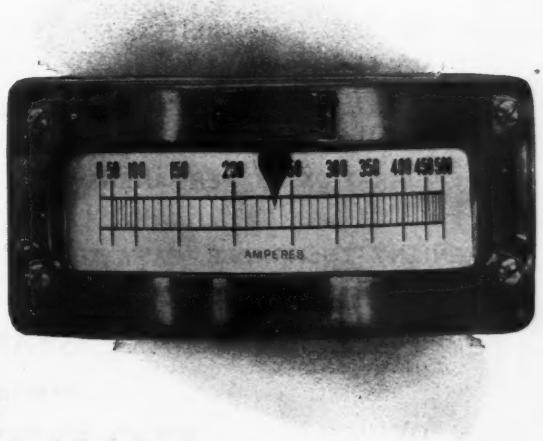

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An absolutely "Dead Beat" Switchboard Instrument.
Send for Prices, Bulletins "V" 31 and 38.

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Integrating Wattmeter

WEIGHS LESS THAN
13 POUNDS AND CAN BE
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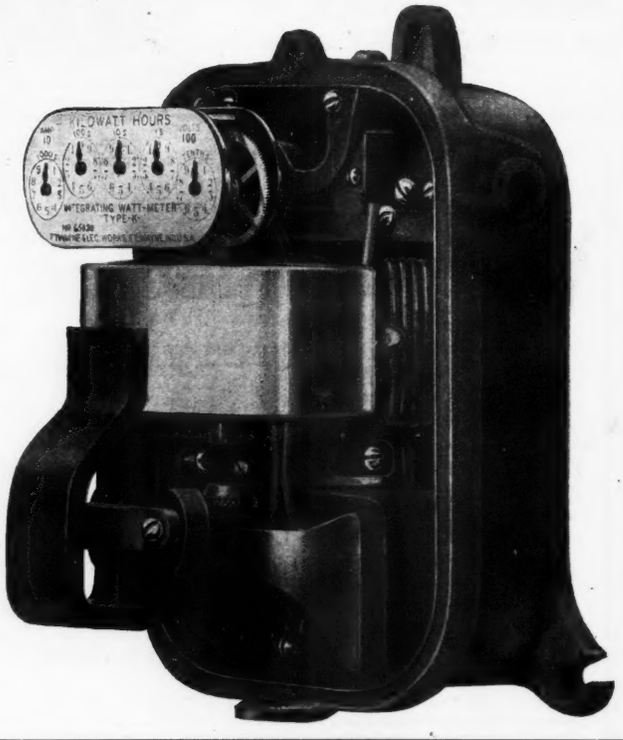
6¾x8¾ inches.



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IT CAN BE QUICKLY ADJUSTED FOR EITHER **HIGH OR LOW FREQUENCY.**

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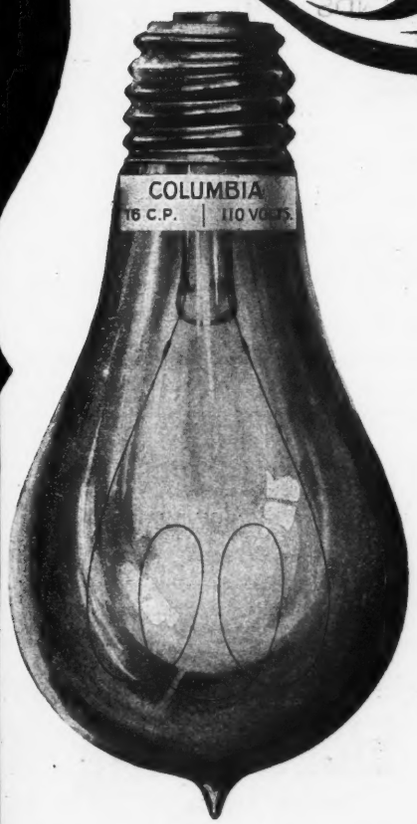
UNEQUALED IN QUALITY



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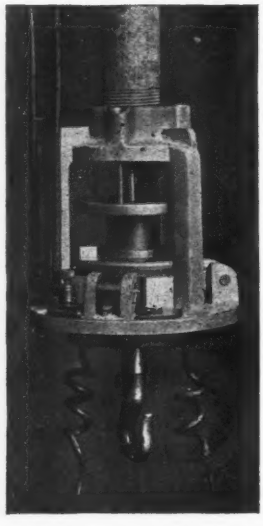

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Automatic Electric Lamp Support

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No springs.
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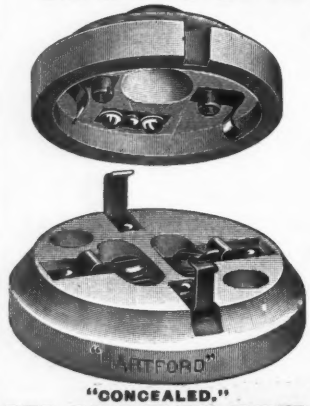

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Positive lock and sure contact.
Cap can not be loosened or contact lessened by shaking or pulling on the cord.

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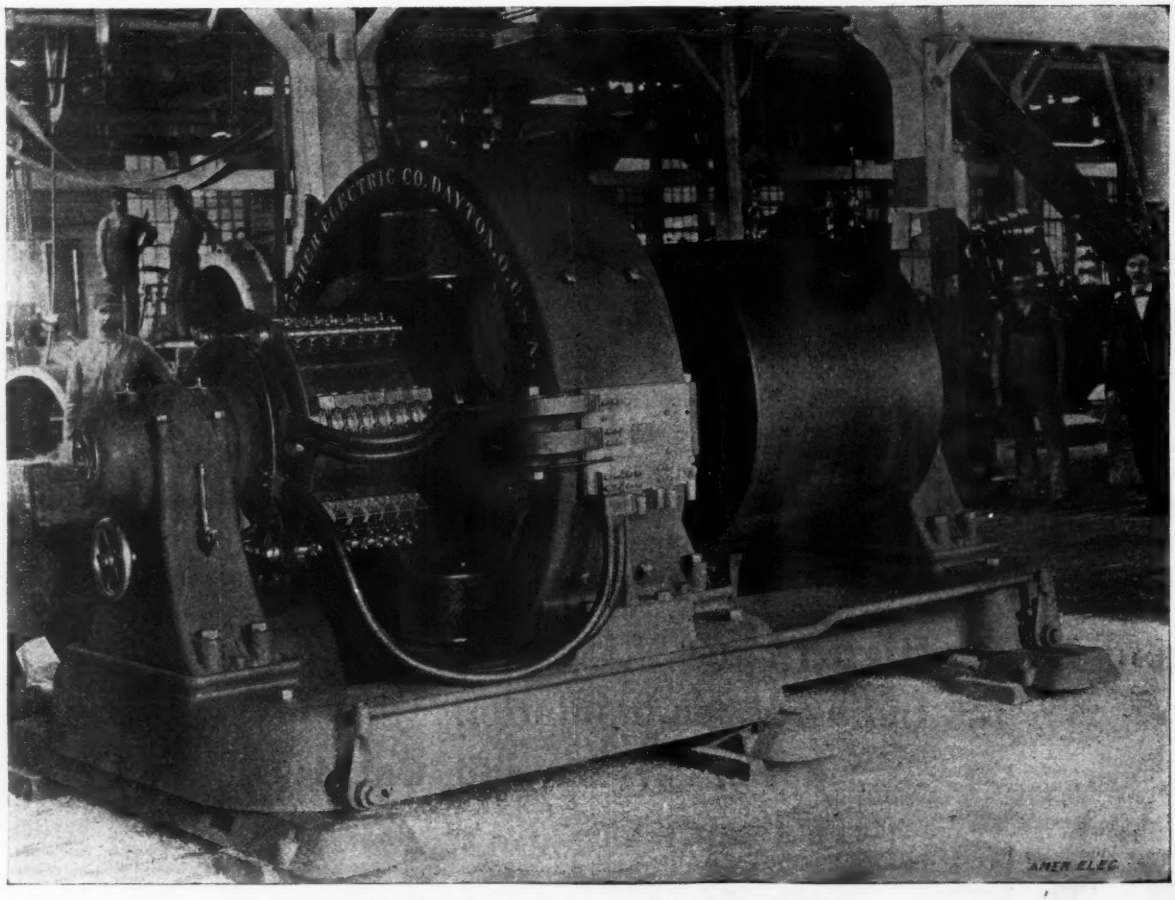

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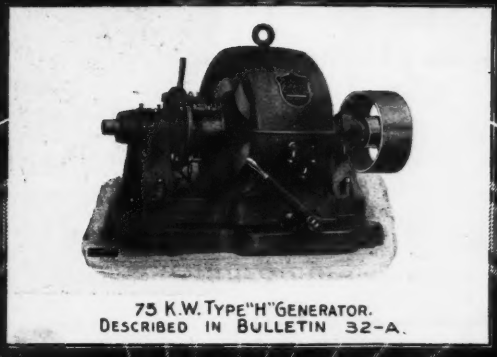

75 K.W. TYPE "H" GENERATOR.
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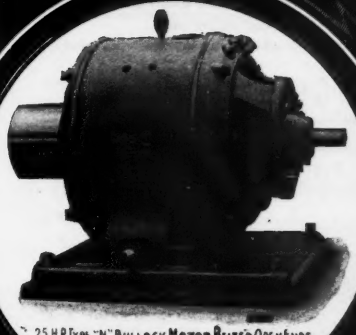

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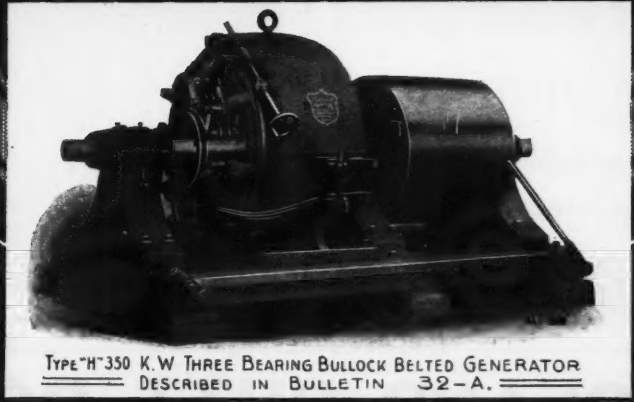

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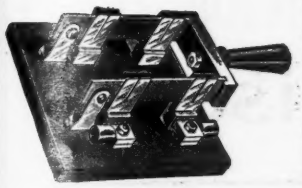

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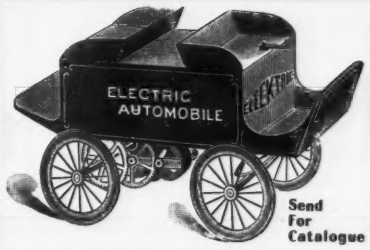

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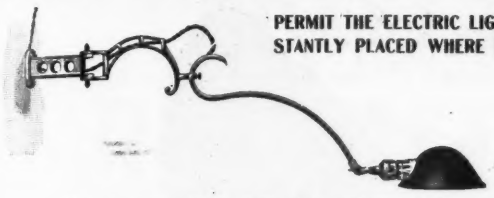

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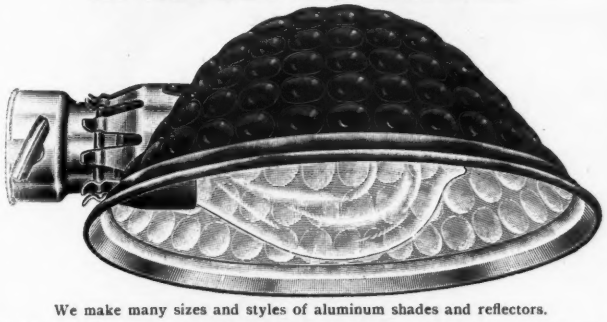

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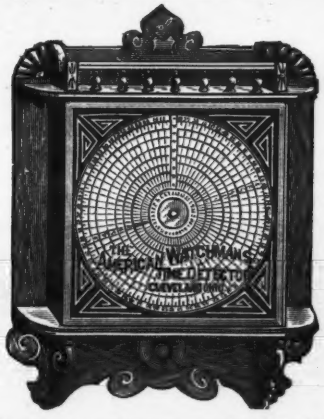
Accuracy ✳ Simplicity ✳ Durability ✳



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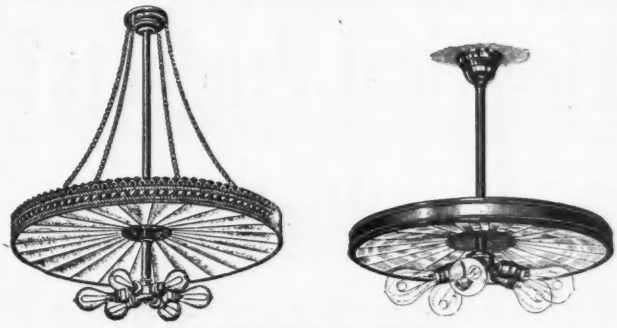
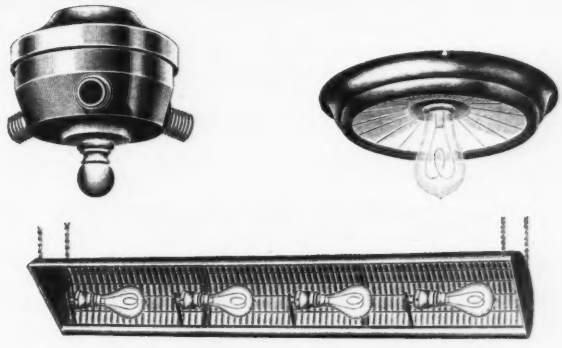
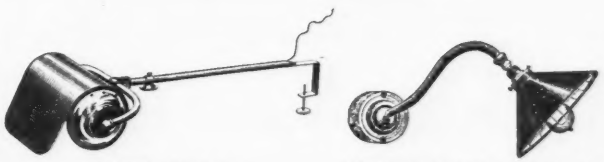


CLUSTER FIXTURES.



WINDOW REFLECTORS.



DESK SHADE. ADJUSTABLE BRACKET.

STREET FIXTURE. TIN SHADES.

MIRROR REFLECTORS.

Our New Catalogue shows many others. Yours for the asking.

WHEELER REFLECTOR CO.

100 Purchase St., BOSTON, MASS.

Do You Manufacture Electrical Products?

Do You Wish to Increase Your Sales?

The Reason these questions are asked is that the advertiser is now opening an office in New York (see "Manufacturers' Representation" advertisements last two issues ELECTRICAL REVIEW), to represent a few manufacturers of electrical apparatus or electrical specialties who may want ***reliable, energetic representation*** in New York, or who may be open for a larger development of sales in that locality.

As the result of these previous advertisements the advertiser is negotiating arrangements for the representation of several distinct lines, and can accept perhaps two more agencies. He is familiar with the electrical industry—has a large acquaintance—is an enthusiastic and successful salesman. Only representative companies need correspond. Reference, by permission, to the ELECTRICAL REVIEW. Address

"Manufacturers' Representation,"

CARE ELECTRICAL REVIEW

Park Row Building, . . NEW YORK.

Big Four

The 'Buffalo Route' to

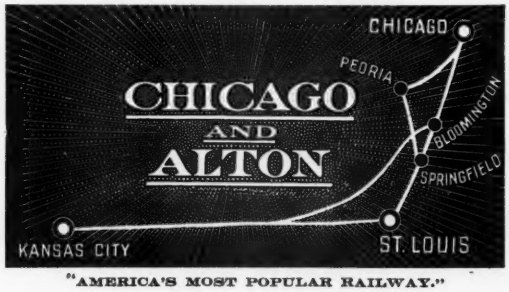
1901 Pan-American Exposition

Big Four Route in connection with Lake Shore & Michigan Southern and New York Central R. R. offers the finest equipped train service at frequent intervals to Buffalo from South and West.

M. E. Ingalls. President.
W. J. Lynch. G. P. & T. A.
W. P. Deppe, A. G. P. A.
Cincinnati, O.

WRITE TO-DAY

FOR RATES, MAPS, TIME-TABLES, ETC., IF YOU ARE CONTEMPLATING A TRIP, ANY PORTION OF WHICH CAN BE MADE OVER THE



"AMERICA'S MOST POPULAR RAILWAY."

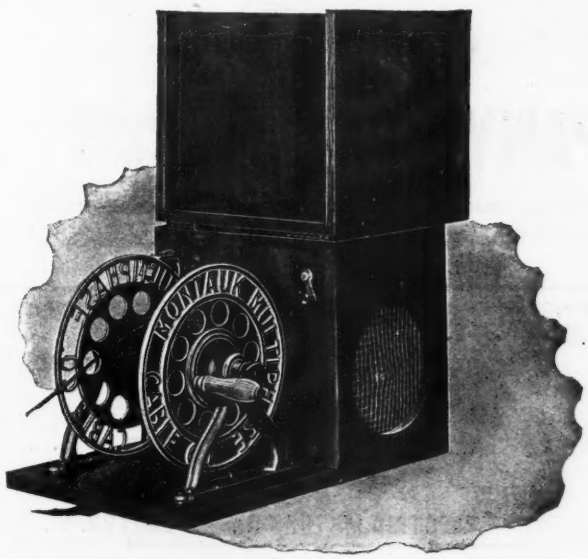
B. L. McCLAIN,
GENERAL EASTERN PASSENGER AGENT,
261 Broadway, New York.

GEO. J. CHARLTON,
GENERAL PASSENGER AGENT,
Chicago, ILL.

MONTAUK ELECTRIC FIRE DETECTING APPARATUS

Montauk Fire Detecting Wire or "Thermostatic Cable"

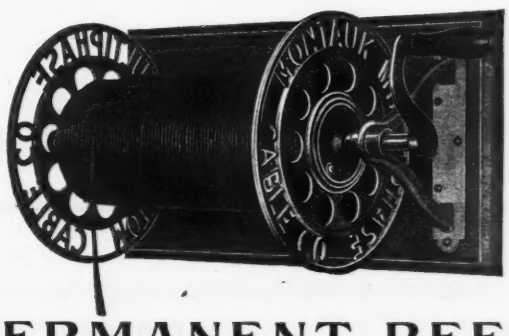
is of a construction that allows its utilization for all kinds of low potential service work, making virtually a convenient form of duplex conductor. Its particular vocation is to give instant automatic notification of fire's outbreak or the generation of dangerous heat in its proximity. This is accomplished by the natural and infalliable law that heat will expand metal. In other words the construction is such that dangerous temperature short-circuits the conductors contained under the one cover, and does it with unfailing promptness. The connections and applications of the wire or cable are but matters of detail.



THE MONTAUK PORTABLE FIRE DETECTOR

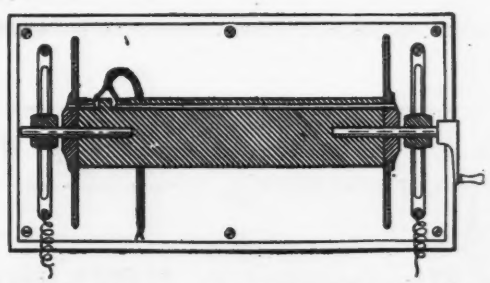
consists of a reel of Montauk Fire Detecting Wire, a 6-inch gong, and the necessary dry battery, all mounted in a suitable wooden case, connected and ready for BUSINESS. Dimensions outside of case, 19 inches long, 8 inches wide, 12 inches high. Reel containing from 300 to 500 feet of fire detecting wire. Weight of whole, about 30 pounds.

BOOKLET No. 55 WILL INTEREST YOU. WE WILL GLADLY SEND IT AND OTHER DESCRIPTIVE MATTER ON REQUEST.



PERMANENT REEL

designed to hold from 300 to 1,000 feet Montauk Fire Detecting Wire and for location in dock and freight sheds, storage warehouses and the like. The wire is ready for instant unwinding and distribution around and over inflammable material, and can be wound up and out of the way with equal facility.



SECTIONAL VIEW OF SPOOL

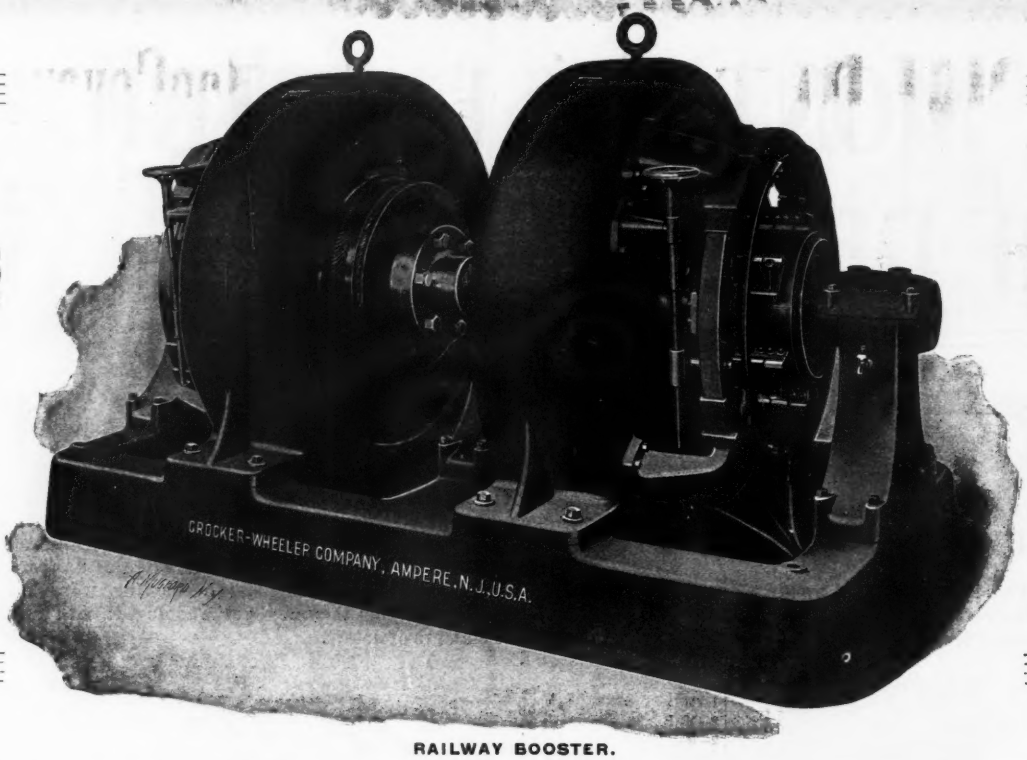
represents a longitudinal central section of the spool, showing the electrical connections and the manner of connecting the thermostatic cable thereto.

MONTAUK MULTIPHASE CABLE CO.

American Surety Building 100 Broadway, New York

RAILWAY GENERATORS

BRANCH OFFICES IN ALL PRINCIPAL CITIES



RAILWAY BOOSTERS

WRITE FOR OUR LATEST CATALOGUE AND ESTIMATE

RAILWAY BOOSTER.

CROCKER-WHEELER COMPANY, Works and General Offices, AMPERE, N. J.

"SHIP" HIGHEST GRADE IMPORTED

CARBONS

SCHIFF, JORDAN & CO.

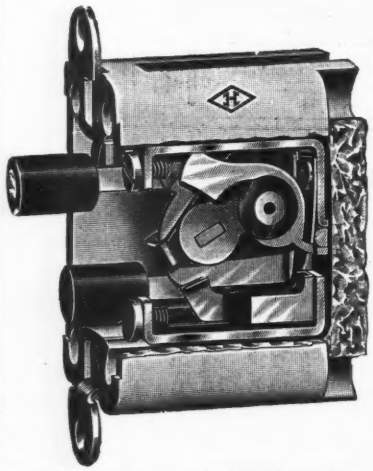
232 GREENWICH STREET, - NEW YORK

THE STERLING MOTOR

One Frame, One Price—Variable Speed, Variable Power

½ H.P. . .	1,200 R.P.M.		
¾ " . .	1,500 "	110 Volts . .	$45.00
1 " . .	2,000 "	250 " . .	47.50
⅜ " . .	900 "	500 " . .	52.00
¼ " . .	600 "		

STERLING ELECTRIC MOTOR CO., - DAYTON, O., U. S. A.



10-AMP., S. P. 10-AMP., D.-P.
10-AMP., 3-WAY. 220 VOLTS.

WHEN YOU CALL on your supply dealer it will be well for you to inquire, if you are interested in push switches and appurtenances, for

"DIAMOND H" PRODUCTS

This Switch is right in every particular. Special attention is called to the sheet mica insulation. It cannot absorb moisture and burn out. It cannot break nor cause trouble in any way.

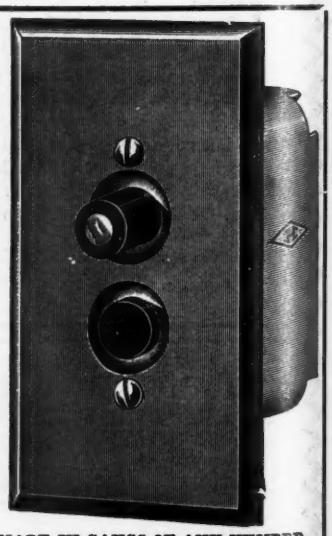
SEND FOR CATALOGUE AND PRICES

HART MANUFACTURING CO.

HARTFORD, CONN., U. S. A.

NEW YORK
WILLIAM TAYLOR, 203 Broadway

BOSTON
SMITH & CROCKETT, 170 Sumner St.



MADE IN GANGS OF ANY NUMBER.

SPECIAL BARGAINS! Rossiter, MacGovern & Co.

LIGHTING APPARATUS.

DIRECT-CONNECTED UNITS.

2—units, each consisting of a 100 Kw. M. P.-8, compound wound, 125-volt Westinghouse generator, and a 13-inch and 19-inch x 15-inch McIntosh & Seymour Tandem Compound High-Speed Engine, for non-condensing duty. Speed 235 R. P. M.

1—unit, consisting of a 100 Kw. M. P., compound wound, 125-volt Siemens-Halske generator, and a 15-inch x 16-inch Syracuse Straight Line High-Speed Automatic Engine.

This apparatus is practically new, having been used only a short time. We fully guarantee it and can quote unusually low prices.

ARC MACHINES.

2—No. 12 Brush, multicircuit, 165-light, 1,200 C.-P., Arc Dynamos.

2—No. 11 Brush, multicircuit, 125-light, 2,000 C.-P., Arc.

2—No. 9 Brush, single-circuit, 80-light, 2,000 C.-P.

3—125-light, 2,000 C.-P., Fort Wayne Arc Dynamos of the latest type.

2—150-light, 2,000 C.-P., Excelsior Arc Dynamos of the latest type, brand new.

4—40-light, 2,000 C.-P., T.-H., M.-D. Arc Dynamos, ring armatures, self-oiling bearings.

The Brush Dynamos are of the very latest type, and shipment of all the above machines can be made immediately.

ARC LAMPS.

For Alternating-Current Use.

General Electric, Form 2, long-burning enclosed lamps, ornamental brass design for indoor use, each $14.00

General Electric, long-burning, black enamel and weather-proof lamps, double globes, each $12.50.

SERIES ARC LAMPS.

Brush—Thomson-Houston—Fort Wayne—Schuyler.

FOR DIRECT CURRENT.

Enclosed Type.

Lot of General Electric, Manhattan, Jandus, Graves, Adams-Bagnall, and other makes.

Electric railway apparatus and equipment. All the best known makes, such as Westinghouse, General Electric, etc., at prices that will interest every buyer.

RAILWAY GENERATORS.

2—M. P.-6, 500 Kw. Westinghouse, belted.

1—M. P.-4, 500 Kw. General Electric, belted.

1—M. P.-4, 200 Kw. Walker, belted.

2—M. P.-4, 100 Kw. General Electric, belted.

2—M. P.-4, 150 H.-P. Westinghouse, belted.

DIRECT-CONNECTED UNITS.

500 Volts.

1—400 Kw. M. P., General Electric, with Hamilton-Corliss Engine, brand new, immediate delivery.

BOILERS.

16—150 H.-P. Return Tubular Boilers.

2—375 H.-P. Stirling Water Tube Boilers.

2—175 H.-P. Stirling Water Tube Boilers.

ENGINES.

2—40-inch x 72-inch International Power Company, Corliss Engines.

1—38-inch x 60-inch Wetherell-Corliss.

1—26-inch x 48-inch Allis-Corliss.

PREPARE FOR WINTER—BUY YOUR CLOSED CARS.

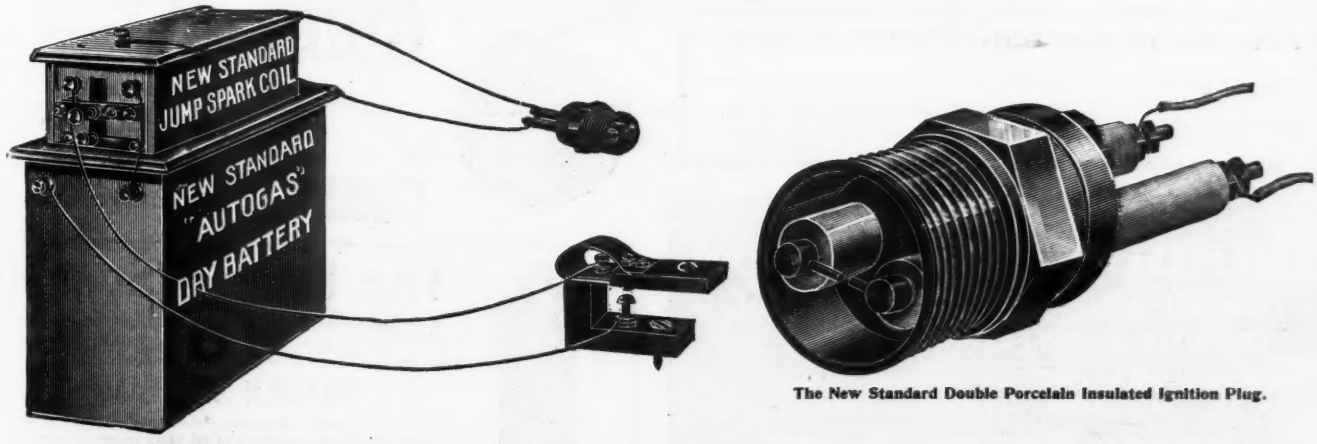
30 Cars made by St. Louis Car Company, 18 feet 6 inches length of body; 26 feet over all; width over sill, 6 feet 1/2 inch; fitted with either McGuire or Brill Single Trucks—7 feet wheel base, 36-inch wheel. Will sell without equipment or can be equipped with either Westinghouse 3, or G. E. 800, or W. P. 50 motors and controllers. Provided with Security registers, clock face pattern.

ROSSITER, MACGOVERN & CO.

PRINCIPAL OFFICES: 141 BROADWAY, N. Y. WORKS: BROOKLYN, N. Y.

THE "AUTOGAS" DRY BATTERY

For AUTOMOBILES, GAS AND GASOLINE ENGINES, LAUNCHES, Etc.



The New Standard Double Porcelain Insulated Ignition Plug.

THIS COMPLETE SET IS MY INVENTION AND SOLD ONLY BY ME. Any size battery made to operate the system. Dry Automobile cell, same size as the French cell, guaranteed superiority, 400 per cent., $5.00 per set of four. Send for complete Catalogue.

WILLIAM ROCHE,

Manufacturer and Sole Inventor "NEW STANDARD" Dry Battery,

42 VESEY STREET, NEW YORK.

ORIENT & COLONIAL
INCANDESCENT LAMPS

A Perfected Product—

PERFECT IN UNIFORMITY.
CANDLE-POWER.
LONG LIFE.

NOT MADE BY THE TRUST.

Colonial Electric Co.

Also makers the "ALADDIN" Incandescent Lamps.

RAVENNA, OHIO.

J. H. BUNNELL & CO., N. W YORK. ST. LOUIS ELECTRICAL SUPPLY CO., ST. LOUIS. JAS. CLARK JR., & CO., LOUISVILLE, KY.

ELECTRIC LAUNCHES

A Paying Investment at Parks and Pleasure Resorts

CAN'T EXPLODE — CAN'T SINK

Simple in Care — Reliable in Operation

No Heat - No Smoke - No Smell

The Electric Launch Co., Ave. A and North St., Bayonne City, N. J.

DIXON'S PURE FLAKE GRAPHITE

Is a blessing to every engine room and machine shop.

A small quantity added to any Oil or Grease largely increases its lubricating value and makes the finest Cooling Mixture.

PAMPHLET AND SAMPLE SENT FREE.

JOS. DIXON CRUCIBLE CO., Jersey City, N.J.

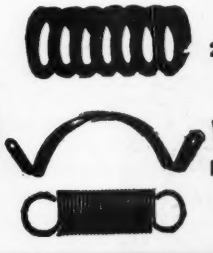
Alternating-Current Power Motors.

1/6 to 2½ Actual Horse-Power.

SIMPLE, RELIABLE, SATISFACTORY. Bulletins giving full description mailed on request.

BRANCH OFFICE AND WAREHOUSE, 136 LIBERTY STREET, NEW YORK CITY

THE EMERSON ELECTRIC MFG. COMPANY, 714-716-718 St. Charles Street, St. Louis, Mo.



Cary Spring Works,

240 & 242 WEST 29th STREET.

NEW YORK CITY.

Manufacturers of

WIRE AND SPRINGS

For Machinery, Motors, Clocks, Music Boxes, and all kinds of Electrical Purposes.

Jandus Arc Lamps

ORIGINAL IN DESIGN, PERFECTION IN DETAIL
CONCEIVED BY A GENIUS

The Development of Experience. Prices Reasonable. Avoid Repair Costs by Buying the Best

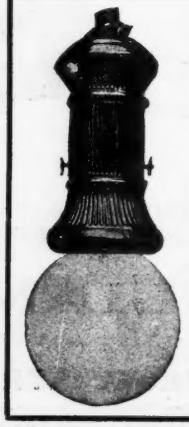
CATALOGUE AND PRICES ON APPLICATION

Robert L. McOuat

SUCCESSOR TO

Varney & McOuat

ELECTRICAL SUPPLIES — INDIANAPOLIS, IND.



The Belden System

of arc lighting accomplishes the many requirements demanded by the most expert and advanced engineers. The principles involved in the construction of the various types of the

BELDEN ARC LAMPS

are he demo strated features of modern enclosed arc lighting The many difficult elements of arc lamp designing are all successfully met in these lamps.

Send for catalogues and further information.

Belden-Larwill Electric and Mfg. Co.,

FORT WAYNE, INDIANA, U. S. A.

Agents: M. B Austin & Co., 58 W. Van Buren St., Chicago, Ill.
C E. Wilson, care Manufacturer's Club, Phila., Pa.
R. N. Stewart & Co., Denver, Colo.

THE NEW SHELBY LAMP

50 to 100% More Useful Light

SEND FOR OUR PAMPHLET CONTAINING OPINIONS AND REPORTS OF TESTS MADE BY PEOPLE YOU KNOW

PATENT APPLIED FOR

Lamps almost invariably hang downward, above the horizontal line of vision.

Objects to be illuminated are beneath.

Light travels in straight lines.

Therefore

THE USEFUL LIGHT is that passing through the end of the lamp.

Think it over

You want the most light for current consumed.

Shelby 10 candle-power lamps consume 40% less current than any make, 16 candle-power.

Shelby 10 candle-power lamps give more USEFUL LIGHT than any single, anchored or double filament lamp of 16 candle-power.

Why do you consider efficiency of light wasted?

There is every reason why you should consider efficiency or cost of light utilized.

Observe candle-power and efficiency in table below. Which is the most economical lamp or which gives the most light for current consumed?

If reflectors are used, or if you consider reflected light from any source, Shelby lamps give an equal amount to reflect.

	C.-P. HORIZONTAL	C.-P. VERTICAL (USEFUL RAYS)	WHEN EFFICIENCY HORIZONTAL IS	EFFICIENCY VERTICAL (USEFUL RAYS)
16 C.-P. SHELBY NEW TYPE TIPPED BULB -	16 C.-P.	14 C.-P.	3.5 Watts	4 Watts
16 C.-P. Anchored Oval Filament - - - - - - -	16 "	7 "	3.5 "	8 "
16 C.-P. Double Filament - - - - - - - - -	16 "	5 "	3.5 "	11.2 "

The Shelby Electric Co.

NEW YORK OFFICE, 141 Broadway
Telephone, 1209 Cortlandt
CHICAGO OFFICE, Home Insurance Building
Telephone, Central 1771
BOSTON OFFICE, 25 High Street
Telephone, Boston 3951-3
DETROIT OFFICE, Chamber of Commerce
Telephone, 2961

LARGE ASSORTED STOCK AT ABOVE BRANCHES

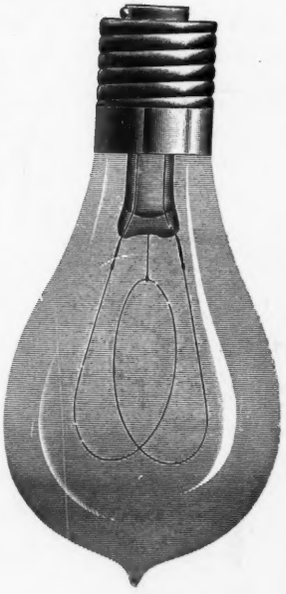
MAIN OFFICE AND FACTORY

SHELBY, OHIO

BUCKEYE INCANDESCENT LAMPS

THESE LAMPS YIELD LONG LIFE AT FULL CANDLE-POWER

as they have filaments differing radically from others manufactured. The great improvement constantly being made in our mode of manufacture has produced a lamp that will slightly rise in candle-power, not passing below its initial candle-power until such time had elapsed when an average lamp would have outlived its usefulness, thus giving the consumer far greater light value. This is accomplished without a decrease of efficiency during life. Any exhaustive test will readily substantiate the above claims for the "Buckeye" Lamp.



THE BUCKEYE ELECTRIC CO.,
Cleveland, Ohio.

Monadnock Building, Chicago.

J. H. COOKE,
1537 Monadnock Building, Chicago.

EDWARD L. NASH,
445 Bourse Building, Philadelphia.

M. A. LAWTON & CO.,
11 Broadway, New York City.

C. S. KNOWLES,
7 Arch Street, Boston.

Good Stock needs Good Lighting.

Any progressive merchant knows this. The better his window display, the greater the necessity for perfectly lighting it. Frink's Patent Special Window Reflector is THE perfect fixture. It has been installed in leading stores throughout the United States. Let us send you a careful estimate on your next job of store lighting, not only on window reflectors but on our unequalled cluster reflectors for lighting the interior, and we will send you a partial list of large mercantile houses to which your customer can refer if he is in doubt about our goods.

"BOOK OF LIGHT" and estimates on all goods free.

I. P. FRINK, 551 Pearl St., New York. Reflectors for all Purposes.

Type "K" Switchboard Instrument.

Switchboard Galvanometer and Ground Detector for Constant Potential Circuits.

Combination Portable Voltmeter.

Six Types of Keystone Instruments.

THESE and all others of the important types and variations for electrical measurements are made by us. They are doing much to establish a higher and more perfect standard for electrical instruments of precision. They are rapidly being adopted by discriminating engineers throughout the world. "THE KEYSTONE" line is the most comprehensive of any American manufacturer, and covers indicating instruments for all the measurements on either direct or alternating-current circuits in both switchboard and portable types.

Send for printed literature relative to Switchboard and Portable Voltmeters, Ammeters, Wattmeters, Ground Detectors and other measuring instruments.

Keystone Electrical Instrument Co.

9th Street and Montgomery Avenue, Philadelphia, Pa.

NEW YORK: 15 Cortlandt Street. **BOSTON:** 170 Summer Street. **CHICAGO:** 603 Manhattan Building.

Polarity Indicator and Detector Galvanometer.

Switchboard Potential and Current Indicator.

Portable Voltmeter and Ammeter for Direct-Current Circuits.

Our Students Succeed

Hundreds of students in the electrical courses are receiving more wages for fewer hours' work than when they enrolled. The instruction given by these Schools qualifies students for advanced positions in all branches of engineering. Following are letters from students who have been benefited by their studies.

NOW AN ELECTRICAL SUPERINTENDENT.

It is with great pleasure that I take this opportunity to recommend the Schools. I consider that the Course I have been taking has been a means of personal improvement, as well as having advanced me in position and salary. I enrolled for a Course in Electric Power and Lighting. Before I had fully completed the studies of the Course, I secured, through the recommendation of the Schools, the position which I now hold as electrical engineer for the Blakeley light plant, of Peckville, Pa. With the position also came an increase in salary.

EDGAR M. BARNES,
Peckville, Lackawanna County, Pa.

MONTHLY SALARY ADVANCED $70.

When I enrolled in the Electrical Engineering Course, I was foreman of the dynamo room for the Cumberland Electric Light & Power Company, of Nashville, Tenn., and I did not think I would ever be able to fill a better position. About a year ago, however, I took up the above Course, and soon found myself capable of taking any position about a station. A short time ago I was offered the chief engineer's position, and am able to satisfactorily fill the place. My salary has been increased from $80 per month to $150 per month, and the Schools did it for me.

WM. J. DODGE,
119 Foster St., Nashville, Tenn.

Instruction by mail in all branches of Electrical, Steam, Mechanical, Civil and Mining Engineering; Chemistry; Sheet Metal Pattern Drafting; English and Commercial Branches.

Send for Circular and Local References, Stating Subject in Which Interested.

The International Correspondence Schools,

BOX 1003, SCRANTON, PA.

THE COMMON COUNCIL OF AMSTERDAM will receive on or before the 16th day of October, 1900, proposals for lighting the streets and public places of said city with 165 or more alternating or direct-current enclosed long-burning arc lamps, consuming 450 watts at the arc; and 50 or more incandescent lamps, 25 candle-power capacity; also, bids for erecting, operating and maintaining 165 or more arc lamps and the 50 or more incandescent lamps herein mentioned; the city supplying the necessary electrical energy, which will be of the alternating type, of about 7,200 alternations per minute. Bidders shall submit proposals upon a contract for a period of five years, also for a period of ten years. The city reserves right to reject any or all bids. Copies of specifications will be mailed to anyone requesting same.

THOS. J. HAZLETT, City Clerk.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc.

Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

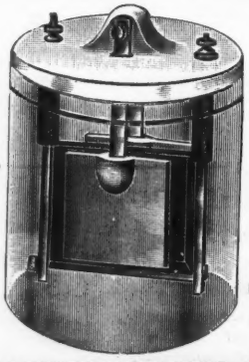
Hair Springs of any description manufactured to order.

F. N. MANROSS, Forestville, Conn.

The entire FALL and WINTER SEASON—1900-1901—will be an era of splendid Electrical Development. The ELECTRICAL REVIEW will be kept in touch with the Electrical Industry. Do you read it?

EDISON-LALANDE BATTERIES.

FOR GAS ENGINES,
SLOT MACHINES,
AUTOMOBILES,
RAILROAD SIGNALS,
CROSSING BELLS,
SMALL MOTORS,
ETC. ..



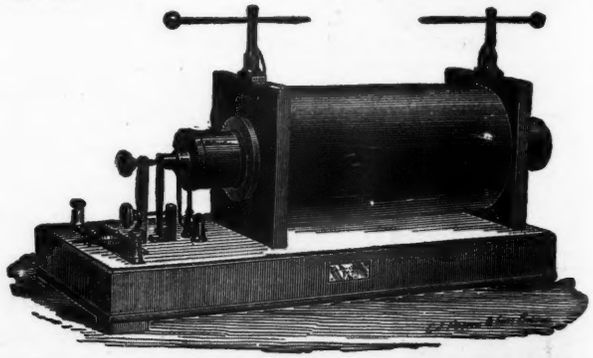
CONSTANT CURRENT,
NO LOCAL ACTION,
WILL NOT FREEZE.
LIQUID TIGHT
CELLS FOR
PORTABLE
WORK.

Full Description in Booklet No. 17.

EDISON MANUFACTURING COMPANY,
135 FIFTH AVE., NEW YORK.

The Ritchie Induction Coils

producing best results in X-Ray work are made by us expressly for this work.



All our coils give a spark from one to two inches above rating. It is known that the founder of this company invented the adopted method of induction coil winding in 1853.

Send for prices and information; catalogue of fine electrical and scientific instruments free.

E. S. RITCHIE & SONS,
Brookline, - - - Mass.

H-P Pat. Enamel Insulated Bridle Rings.

THESE Insulators are made of best quality drop forged iron, heavily coated with glass enamel. They are designed for carrying wires along poles, the walls of buildings, and distributing them to subscribers' offices or stations.

New wires can be readily inserted or taken out at any point and old wires removed from these insulators without injury to either wires or insulators. Strongly made. Will last indefinitely. They can be easily screwed in most difficult and out of the way places by hand. Can be unscrewed, used again and again for other work.

Write for Samples and Prices.

James S. Barron & Co.

General Electrical Supplies,

24-30 Hudson Street, - New York.

THE LENGTH

of our miniature Enclosed Arc Lamp, over all, including glass wall, is only **SEVENTEEN INCHES. IT'S WEIGHT—EIGHT POUNDS.**

Use this lamp in place of clusters of incandescents and where meter bills are too high.

Lea Electric Mfg Co.,

BOX 374, ELWOOD, IND.

SAVE 40 PER CENT IN YOUR LAMP BILLS

Do not throw away your BURNED OUT Lamps. Send them to us and have them RENEWED and made as good as new

Over a Million Lamps Renewed
Every Lamp Guaranteed

Large Stock
Prompt Shipments
Best Facilities

Pioneers in the Renewing Business

LYNN INCANDESCENT LAMP CO.

Lynn, Mass.

Stewart Cord Adjuster.

(Patented August 21st, 1900.)

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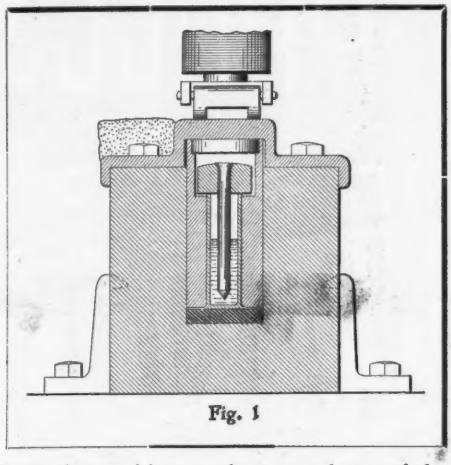

Fig. 1

Fig. 1 shows the working conductor and one of the circuit-closers, consisting of aluminum or copper stem and iron collar.

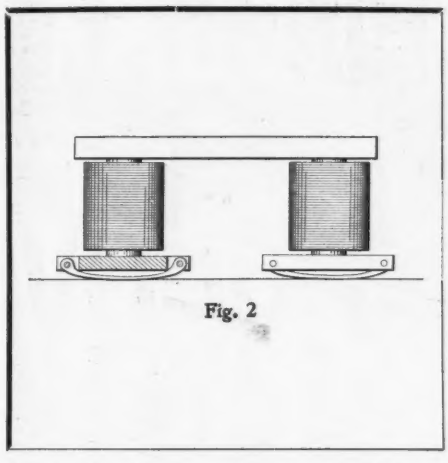

Fig. 2

Fig. 2 shows the electro magnets attached to the car hinged to which are the current-taking devices shown in the same figure.

This system uses a divided or sectional conductor (third-rail), under each section of which are placed the contact-making devices shown in Fig. 1. These consist of cups mounted in insulating blocks and connected with the source of power. In each cup is a small quantity of mercury, in which the point of a rivet-shaped contact-maker plunges. Over the iron head of each contact-maker is a non-magnetic washer on the under side of the sectional rail. The car carries two electro-magnets (shown in Fig. 2), energized by a small storage battery. The poles of these magnets project downward through the collecting brushes, but out of contact with the rail plate, magnetizing it transversely and attracting upward the contact-makers. Thus the section of rail and the magnet is continually energized, while as soon as the car passes the contact-makers drop back, leaving the sectional rail "dead." The entire system laid in a space 8 x 10 inches.

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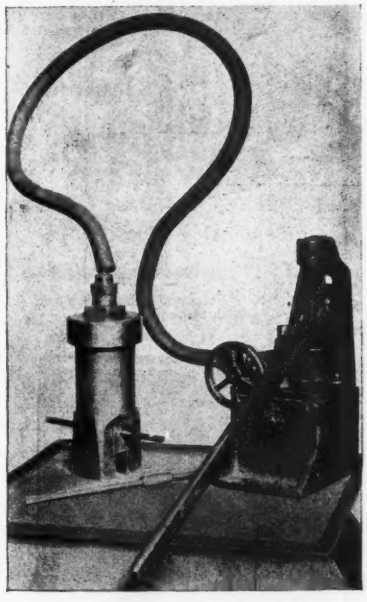

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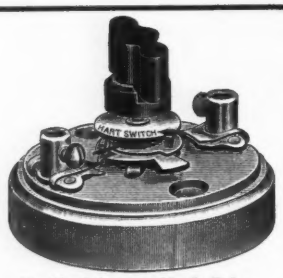

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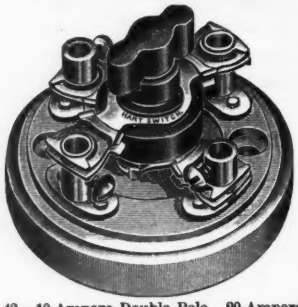

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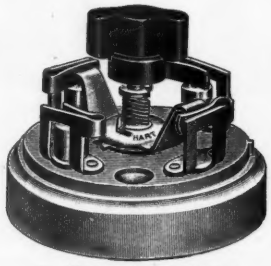

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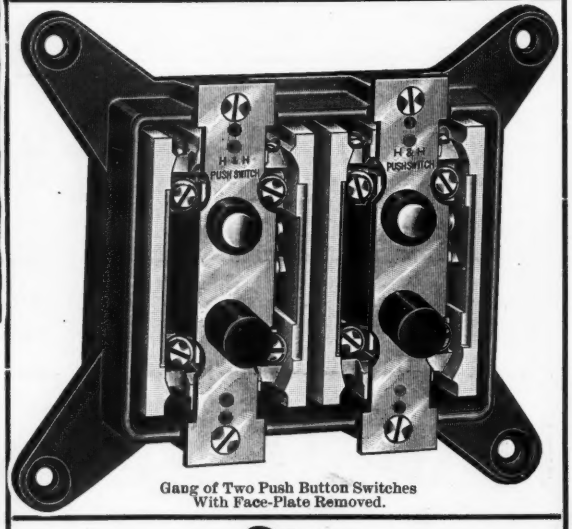
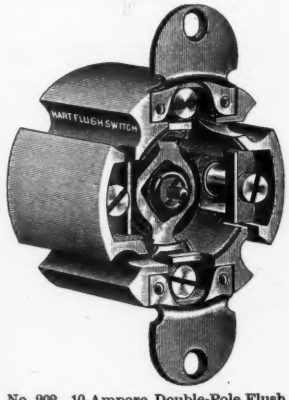


Gang of Two Push Button Switches With Face-Plate Removed.



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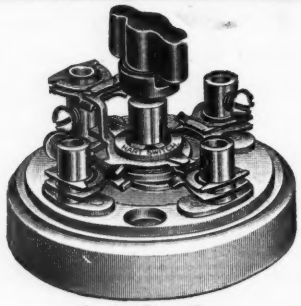

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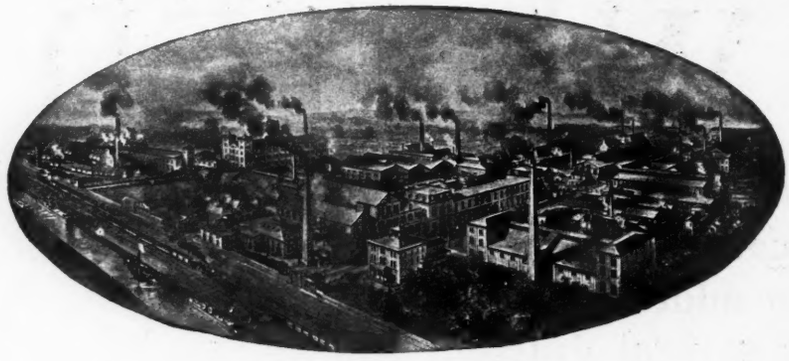

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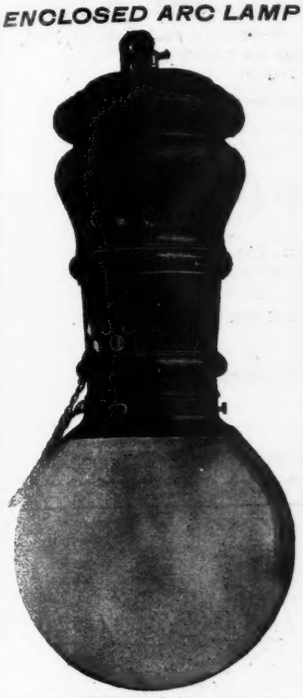

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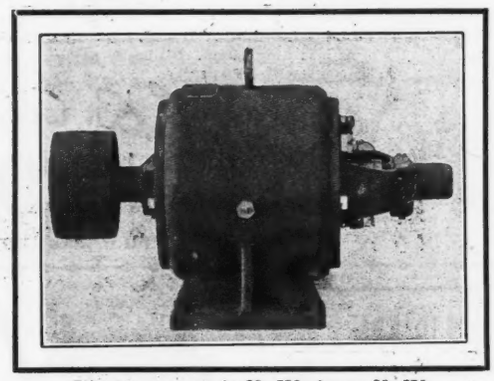

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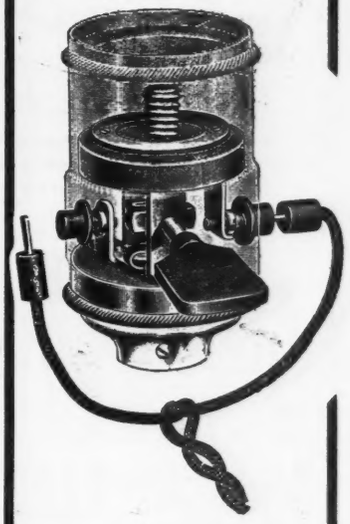

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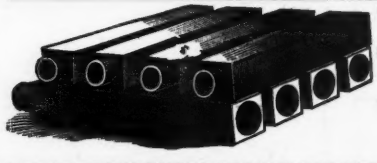

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[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

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658,753 Rail-bond; G.B. Blanchard, Seattle, Wash.

658,792 Circuit-making device; P. M. Lincoln, Niagara Falls, N. Y.—A stationary terminal, a cooperating movable terminal, a solenoid and a core therefore, a rod or stem provided with tripping projections on opposite sides of said movable terminal and movable with said core, and means for retarding the outward or downward movement of said rod or stem.

658,815 Method of producing phase displacement; W. Stanley, Great Barrington, Mass.

658,820 Engraving machine; E. S. Woods, Hartford, Ct.—A reciprocatory tool-holder, a plurality of electro-magnets, and an oscillatory armature connected with and moving said tool-holder and mounted for cooperation with said magnets.

658,821 Electric generator; L. G. Woolley, Kenton, Ohio.

658,860 Cover for battery-jars; P. P. Nungesser, Cleveland, Ohio.

658,862 Telegraphophone; E. C. Paramore, Philadelphia, Pa.

658,865 Secondary battery; H. C. Porter, Chicago, Ill.

658,891 Electrode and electrode connection; H. Carmichael, Malden, Mass.

658,900 Battery fluid; G. Romanelli, New York, N. Y.—Consists of cupric chlorid mixed with sulphate of sodium.

658,905 Electric-current regulator; D. Watkins, Davenport, Iowa—A movable volt-indicator, a pair of pins at the side thereof adapted to be electrically connected by contact with said indicator, a rheostat, an electro-magnetic device connected with said pins and adapted to be energized upon

(Continued on page 52.)

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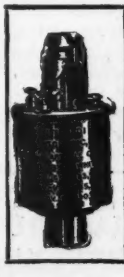
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(*Continued from page 51.*)

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658,924 Electrical fitting; W. T. Pringle, Lansdowne, Pa.

658,925 Electric switch: N. D. Rand, Watertown, Mass.—A base contact-points secured thereto, a portion only of which are provided with binding-posts, means for grouping said points, and movable switch-arms, each provided with means for completing a different circuit through said contact-points.

658,929 Electrical semaphore system; J. Shoecraft, Topeka, Kan.

658,976 Lightning arrester; F. B. Cook, Chicago, Ill.

658,997 Electrical propelling apparatus; D. Perret, Neufchatel, Switzerland.

659,061 Electric lamp; F. L. Fowler, Philadelphia, Pa.

659,096 Combined relay and repeater for telephone lines; E. C. Paramore, Philadelphia, Pa.

659,142 Crossing for suspended electric conductors; J. Floyd, Washington, D. C.

659,152 Open-switch detector; J. M. McCauley, Binghamton, N. Y.

659,169 Mechanism for supplying power to electric cars; G. Gale, Boston, Mass.

659,178, 659,179 Electric railway system; E. C. Morgan, Chicago, Ill.

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11,859 Electric railway; J. B. Entz, Philadelphia, Pa.

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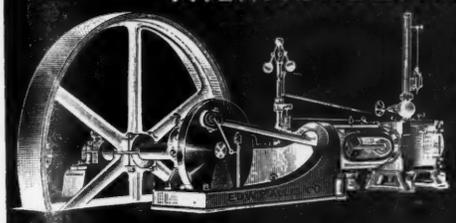

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⅞	15.04	138.12	155 03	223.61	84 55	⅞	16.56	187.75	92.13	146.73	84.78
¾	15.11	127.67	133.24	191.06	83.68	¾	17.33	178.50	83.95	138.40	83.88
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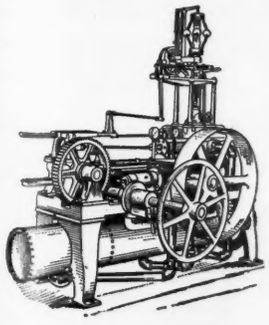

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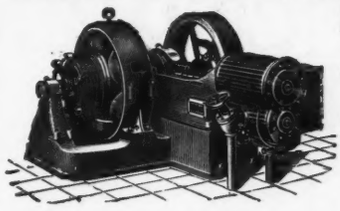

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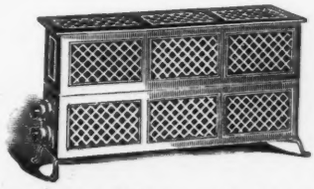

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Ohio Electric Works.
Stanley & Patterson.
Stewart, Frank H., & Co.
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Hewitt-Lindstrom Motor Co.
Thresher Electric Co.

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New England Engineering Co.
Scheaf & Jaastad.
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Diehl Manufacturing Co.
Emerson Electric Mfg. Co.
General Electric Co.
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Michigan Electric Co.
Robbins & Myers Co.
Sprague Electric Co.
Towle, Geo. C., Mfg. Co.
Warren Electric & Specialty Co.
Western Electric Co.
Wagner Electric Mfg. Co.

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Garl Electric Co.

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Chicago Fixture Co.
White Co., O. C.
White Mfg. Co., J. H.

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American Electric Fuse Co.
General Electric Co.
McIntire Co., The C.

Globes, Shades, Etc.
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Phœnix Glass Co.

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Bristol Co., The
General Electric Co.
Gen'l Incandescent Arc Light Co.
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Norton Electrical Instrument Co.
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Whitney Electrical Instrum't Co.

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Case Brothers.
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Locke, Fred M.
Peru Electric Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co.

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Bossert Electric Construction Co.
Gen'l Incandescent Arc Light Co.

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Central Electric Co.
General Electric Co.
Gen'l Incandescent Arc Light Co.
Hamblin, John A.
Jandus Electric Co.
Lea Electric Mfg. Co.
Lea-Hoover Mfg. Co.
Manhattan Gen'l Construction Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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Gen'l Incandescent Arc Light Co.

Lamps, Incandescent.
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Colonial Electric Co.
Columbia Incandescent Lamp Co.
Eastern Electric Co.
General Electric Co.
Gen'l Incandescent Arc Light Co.
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Lynn Incandescent Lamp Co.
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Sawyer-Man Electric Co.
Shelby Electric Co.
Westinghouse Electric & Mfg. Co.
White Co., O. C.

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Electric Launch Co.

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United Electric Heating Co.

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Siegrist Lubricator Co.

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General Electric Co.
Westinghouse Electric & Mfg. Co.

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Garvin Machine Co.

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Brady, T. H.
May, H. A.

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Fort Wayne Electric Works.
Siemens & Halske Electric Co.

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Munsell, Eugene.

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Franklin Model Shop.
Parsell & Weed.

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Burt Mfg. Co.

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Siggers, E. G.
Van Size, W. B.

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Central Mfg. Co.
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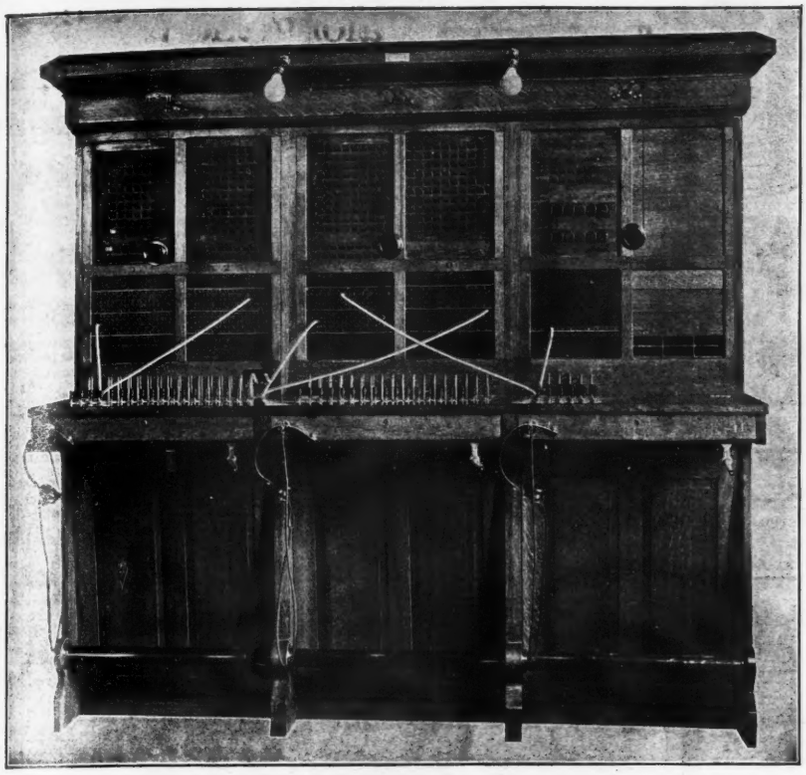

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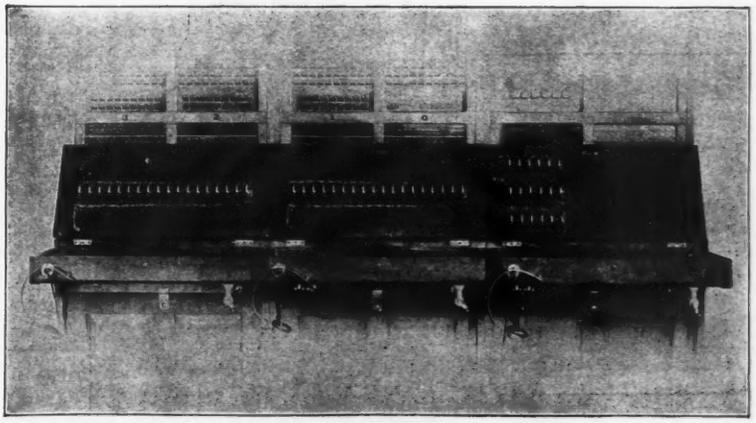

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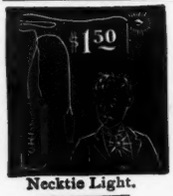

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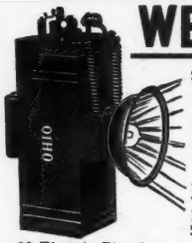

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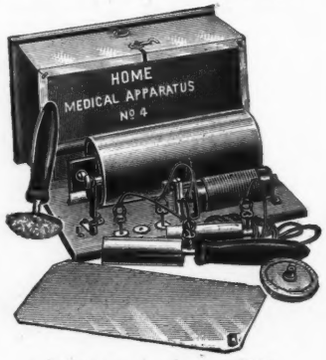

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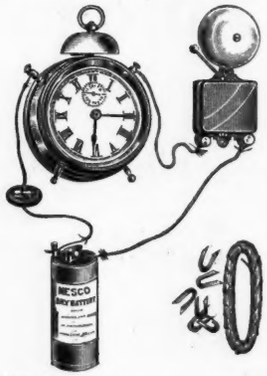

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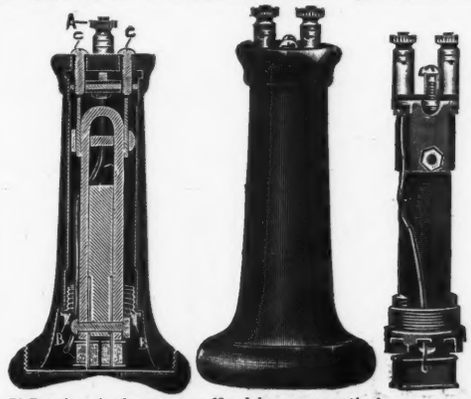

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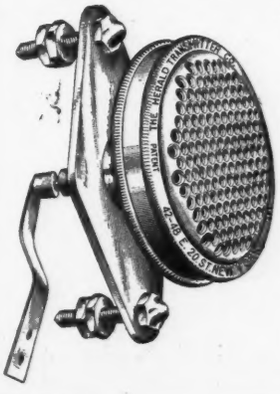

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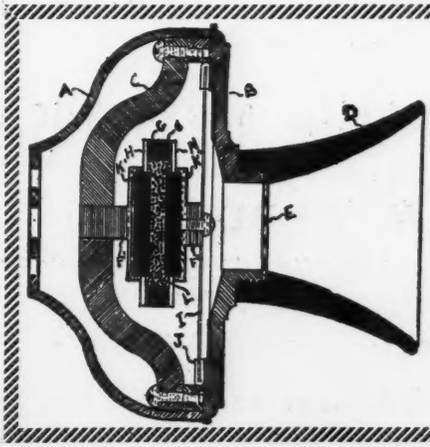

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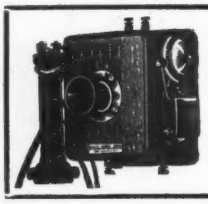

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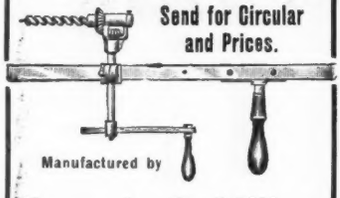

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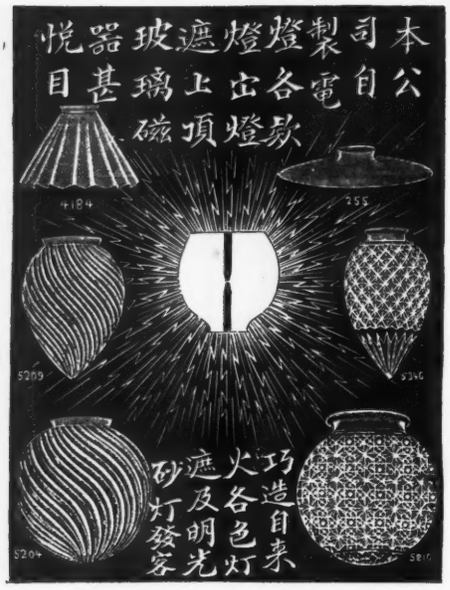

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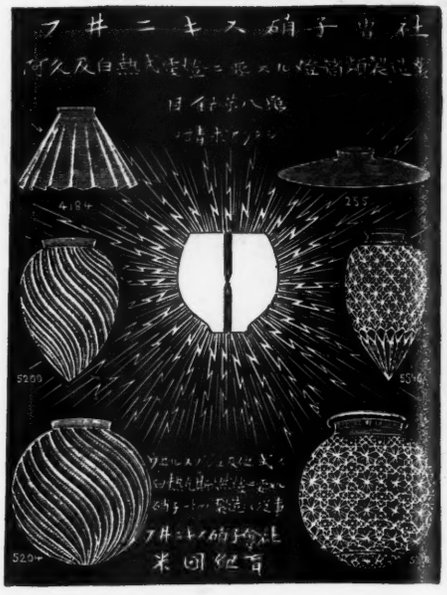

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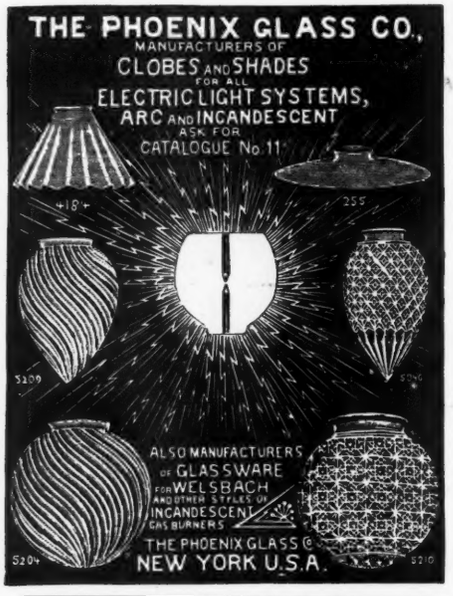

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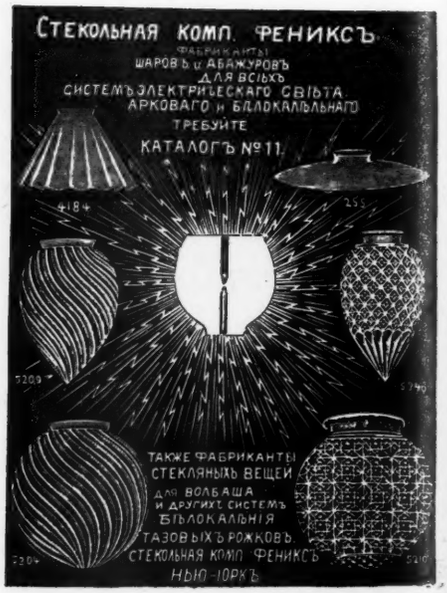

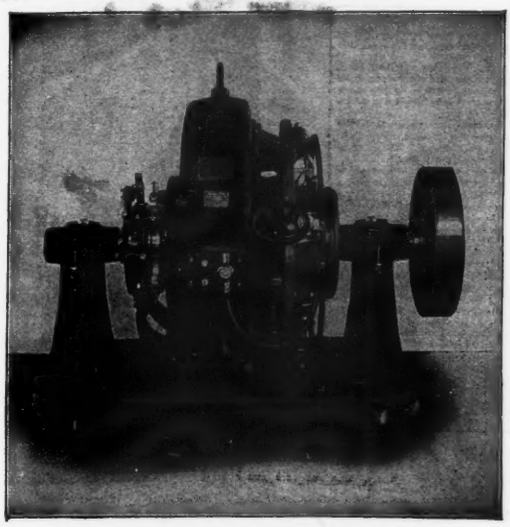

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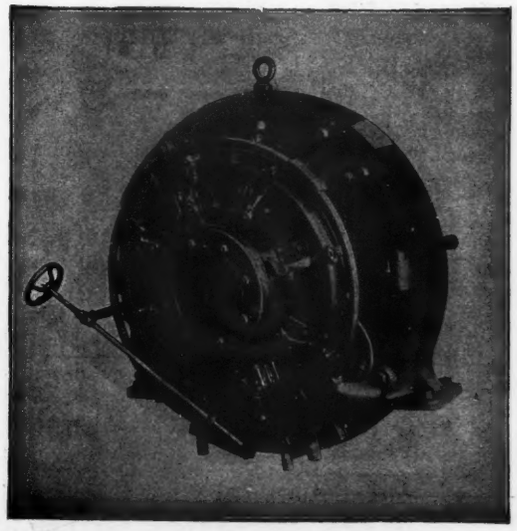

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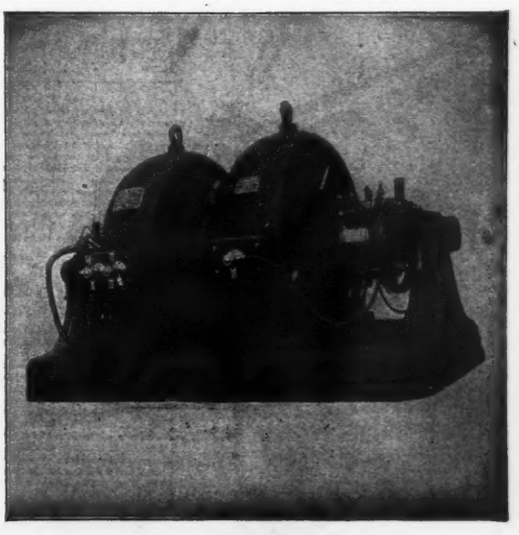

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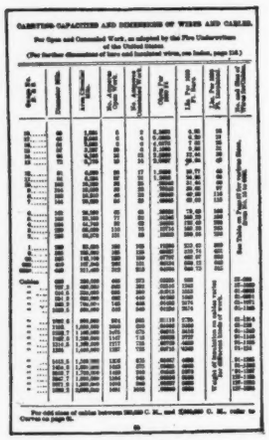
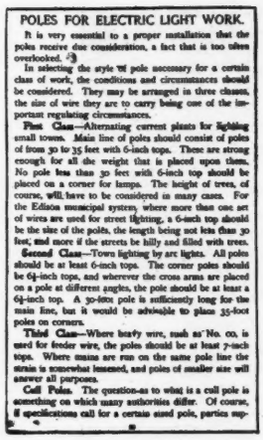


Sample page of tables.



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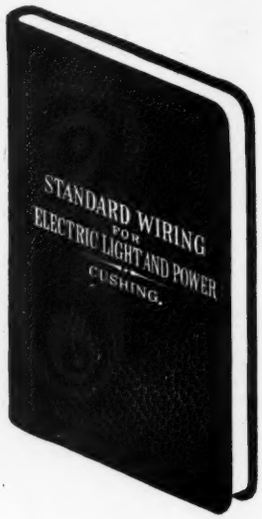
Second Class—Town lighting by arc lights. All poles should be at least 6-inch tops. The corner poles should be 6½-inch tops, and wherever the cross arms are placed on a pole at different angles, the pole should be at least 6½-inch top. A 30-foot pole is sufficiently long for the main line, but it would be advisable to place 35-foot poles on corners.

Third Class—Where heavy wire, such as No. 00, is used for feeder wire, the poles should be at least 7-inch tops. Where mains are run on the same pole line the strain is somewhat lessened, and poles of smaller size will answer all purposes.

Coil Poles. The question as to what is a coil pole is something on which many authorities differ. Of course, if specifications call for a certain sized pole, parties sup-

Sample page, outside work.



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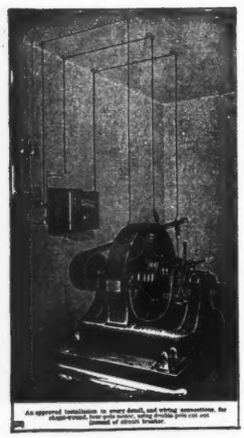

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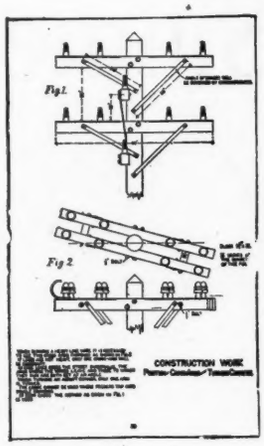
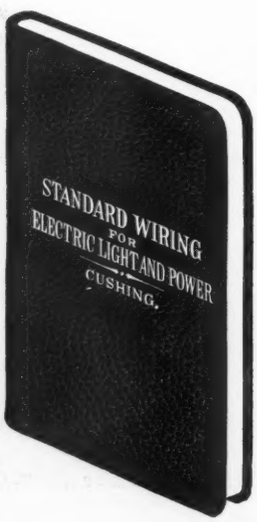
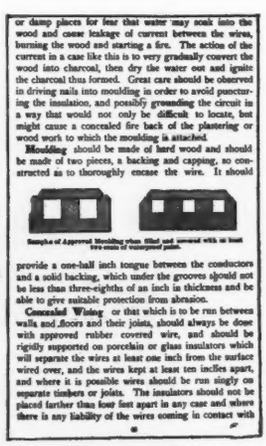


Sample page, pole work.





or damp places for fear that water may soak into the wood and cause leakage of current between the wires, burning the wood and starting a fire. The action of the current in a case like this is to very gradually convert the wood into charcoal, then dry the water out and ignite the charcoal thus formed. Great care should be observed in driving nails into moulding in order to avoid puncturing the insulation, and possibly grounding the circuit in a way that would not only be difficult to locate, but might cause a concealed fire back of the plastering or wood work to which the moulding is attached.

Moulding should be made of hard wood and should be made of two pieces, a backing and capping, so constructed as to thoroughly encase the wire. It should

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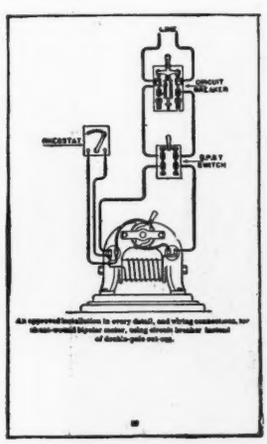
Sample page, inside work.



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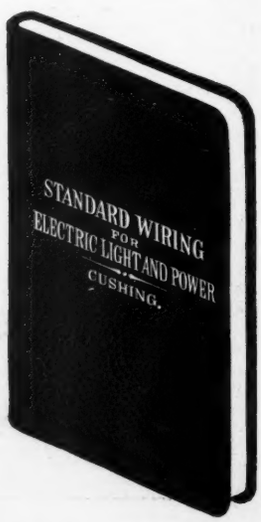
Sample wiring diagram.



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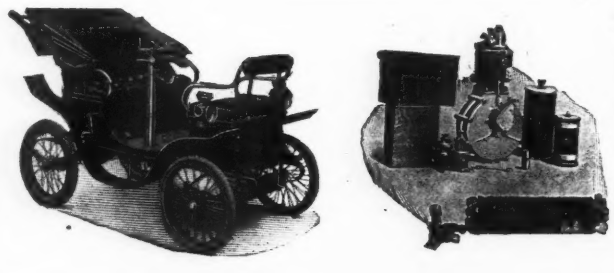

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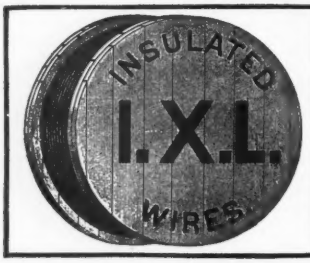

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73,000,000 feet of our Conduit and thousands of miles of our Cables in use in United States, Canada and the British Isles.
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Only Fire Detective Wire in the World
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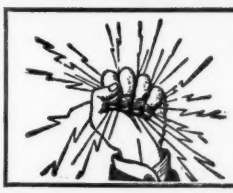
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Would like to send you our new Catalogue, illustrating our MATCHLESS ELECTRIC CIGAR LIGHTER, and also a full line of Bell, Battery, Telephone and Telegraph supplies.
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Discounts Changed, September 15, 1900
Give specific requirements and ask for prices
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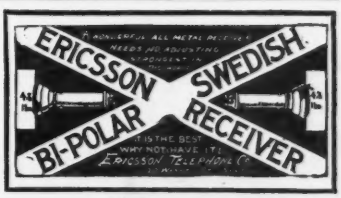

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INCANDESCENT LAMPS, FAN MOTORS, TRANSFORMERS

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SIMPLEX WIRES AND CABLES
FOR UNDERGROUND SUBMARINE LINE AND INSIDE CONSTRUCTION
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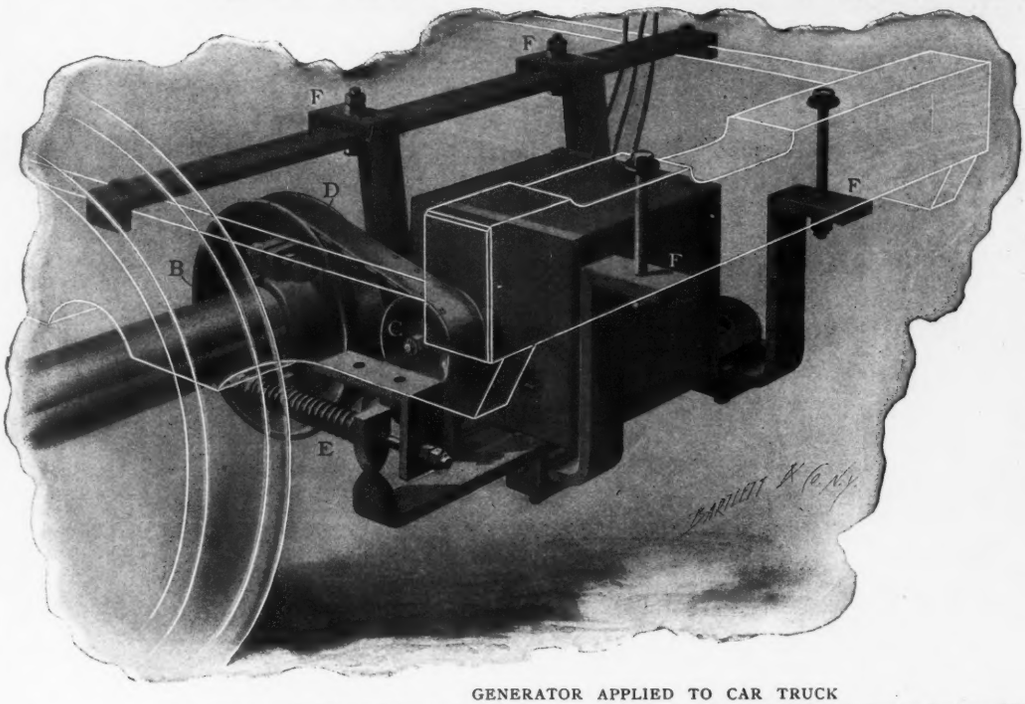
For Railway Passenger Cars



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The "Axle Light" equipment is automatic in its operation. Each car carries its own lighting apparatus. Cost of maintenance insignificant.

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A, Dynamo; B, Driving Pulley on Axle; C, Armature Pulley; D, Flexible Gearing; E, Tension Spring; FFFF, Hangers.

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OUR

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OIL TRANSFORMERS

Capacities from 5 to 1200 lights

Our Bulletin No. 1013
Will give you details
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Low Core Loss
Interchangeable Primaries and Secondaries
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The three-fourths inch Black Manson Tape is now being furnished in Tin Boxes holding one roll, or half-pound. Convenient to use. Keeps the tape fresh and moist.

Price in 100 pound lots or over, per pound, $0.50.

In less than 100 pound lots, per pound, $0.55.

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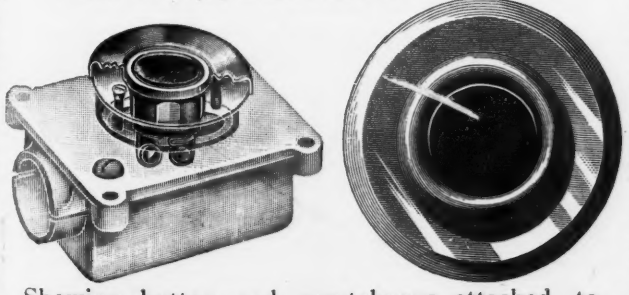
FOR CARS, DESKS AND HOUSES



Showing button and escutcheons attached to conduit box direct without using a wood mat.

Perfectly insulated and centres will not turn or loosen.

Midget, Jr., Push Fits in ⅝-in. hole. Is ¾-in. deep and ¾-in. face.

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Send for a Fall catalogue of door openers, door switches, electric bells, annunciators, push-buttons, electric fire-alarm gongs, car pushes and electric specialties, etc.

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Gould Batteries give greater efficiency for less weight than any other battery.

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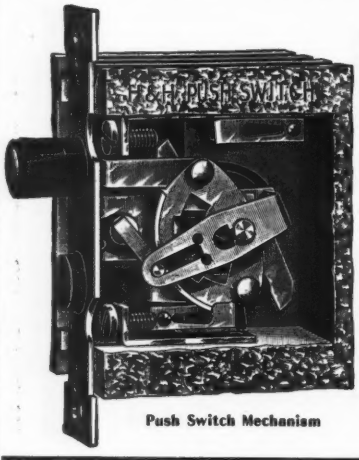

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Well Made

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HIGH-GRADE PROTECTED TYPE ..DYNAMOS..

Direct Current 2 1-2 K.-W. Multipolar Machine

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Dynamos, Motors, Watchman's Registers, Testing Bells, Burners, Etc.

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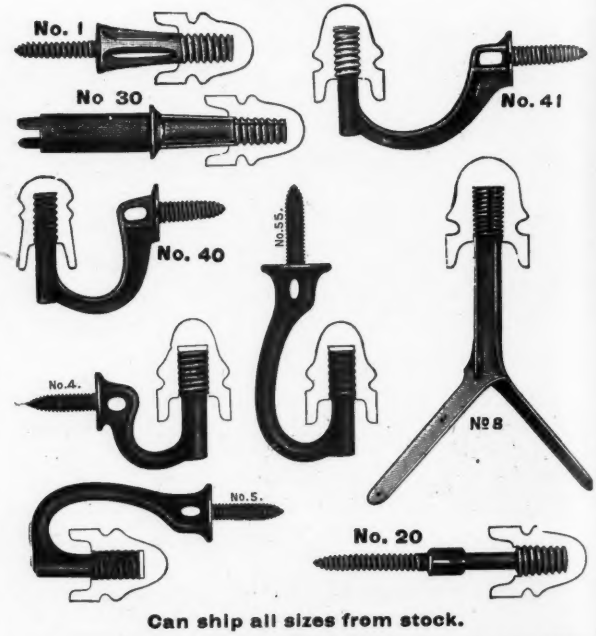

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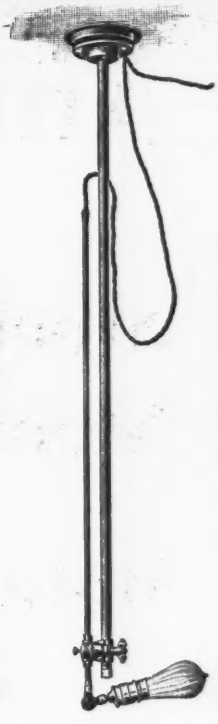
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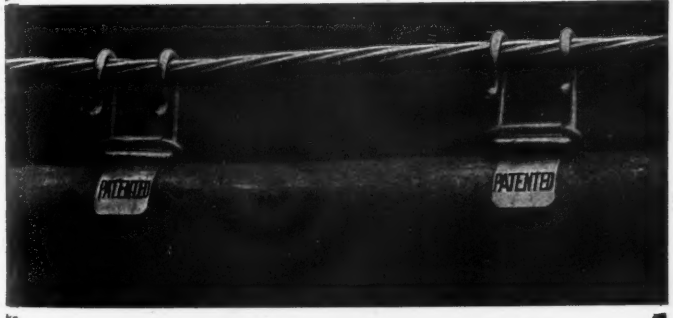
Boston Cable Clip



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THEY ARE THE BEST THEY WILL NOT SLIP THE MOST ECONOMICAL
ADJUSTABLE TO ANY SIZE CABLE THE MOST DURABLE

(Millions NOW in use)

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Our Iron-Clad Type Of Field Rheostat

Field Rheostat mounted on rear of board.

Is compact, ornamental and fire-proof. It runs cool and gives close regulation to the dynamo. In fact it is mechanically and electrically perfect. If it is not all we claim, or entirely satisfactory, we will refund your money. Write for prices and catalogue R.

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AND BUILDERS OF

Steel Bridges, Steel Buildings,

and all classes of

Metallic Structures

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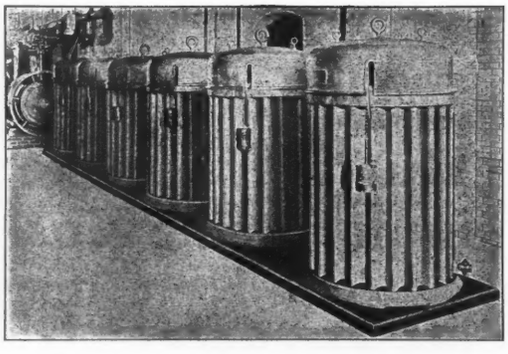
THE GENERAL ELECTRIC COMPANY'S

Series Alternating Street System Constant-Current Transformers and Enclosed Arc Lamps



Series Incandescent Lamps can be operated on the same circuits with the arc lamps, because the transformers do not "pump" at full load.

The Lamp Circuits are entirely insulated from the primary circuit.

12,000 Arc Lamps successfully operating from 290 transformers in 155 different stations.

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By RIPLEY D. SAUNDERS—and others.

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And fortune seems burdened with spite;
Don't give way to grieving, all dismal and blue,
That never set anything right!
But cheerfully face what the day may reveal,
Make the best of whatever befall!
Since the more that you worry the worse you must feel,
Why waste time in worry at all?

We all have our troubles, some more and some less,
And this is the knowledge we gain:
It's work and a brave heart that lightens the stress
Of a life's share of sorrow and pain.
Then face with this knowledge life's cruelest deal,
Too plucky to faint or to fall;
Since the more that you worry the worse you must feel,
Is it wisdom to worry at all?

When lions are guarding the bridge you must cross,
And fate seems to leer in disdain,
Take heart and have at them—there's never such loss
But what a brave man can regain;
For wisdom refuses to worry or fret,
But smiles with a joy recondite;
And wise electricians are happier yet
When using renowned OKONITE!!

OKONITE TRADE MARK.

Resistance Wires.

ALL DEGREES OF RESISTANCE
FOR VARIOUS KINDS OF WORK

Driver-Harris Wire Co.

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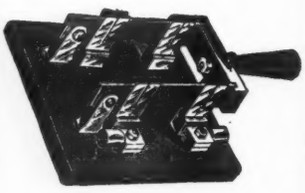

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Quick-Break Switches.
Fusible Switches.
Special Switches.

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A time and labor saver, also danger-proof
Automatically disconnects current wires on lowering of lamp

Pamphlet sent free on application

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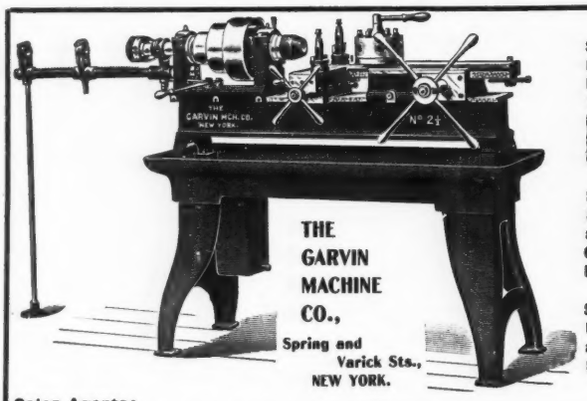

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Twenty-nine 3½x6-in. pages with 14 illustrations.

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January 12, 1901 (the beginning of the twentieth century and the twentieth year of the **ELECTRICAL REVIEW**), will be the date of an **HISTORICAL NUMBER (NEW YEAR)** of the **ELECTRICAL REVIEW**, in which will be traced the birth and rise of the electrical arts in all their applications.

The work has been in process for a year, as it has been the purpose to present at this moment, in a series of especially contributed, illustrated articles in a single issue, the stories of the early inspirations and careers of the electrical inventors; the embryonic and crude stages, step by step, through which theories were carried into practice and to final consummation in finished electrical achievement at the beginning of the twentieth century—sure to be the electrical century.

The plan of these articles is such that electricians and scientists throughout the world will be attracted and laymen fascinated. It will be the first great effort, and, perhaps, the last opportunity to present in concise, practical and technical form these facts of history written by men who were active contributors in electrical work in the last generation of the closing century.

In addition, the regular departments of news, industrial reviews, descriptions of new apparatus, etc., etc., will be fully covered in this number.

Number Twentieth Century

Attractions to Advertisers in This Number

The circulation of the January 12, 1901, **HISTORICAL (NEW YEAR) NUMBER** of the **ELECTRICAL REVIEW** will be something larger than we have ever undertaken: Larger, we think, than has ever been accomplished for a single issue of any electrical journal.

Already orders have been accepted for the sale, through special sources, of many thousands of extra copies. It is also the purpose, in line with the previously announced plan of increasing the circulation during the year, to put a specially marked copy of the **ELECTRICAL REVIEW** of January 12, 1901, in the hands of every intelligent person identified with the electrical industry throughout the world, whose name is not already on the mailing list and who is a possible subscriber.

The issue in the fullest sense will be a "Double Export and Domestic Number," with much more than double American and foreign distribution.

The advertising pages will, in themselves, be a splendid reflection of the status of the American electrical arts in all their multitudinous branches. Those pages in that number will be made more than ordinarily attractive in typographical and artistic effect, and they are sure to be studied with unusual care because of their volume and completeness. It is aimed to make the advertising a most interesting feature of the issue. Regular advertising rates for space in this number will be charged. For preferred locations, special quotations will be made.

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ST. LOUIS, MO., 818 Lincoln Trust Bldg.
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ALL PERSONS
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AND A

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THE

Perfect Enclosed Arc Lamp.

Economy, quality of light, cleanliness, length of life of lamp, steadiness of light, small consumption of current, easiness of retrimming, adjustable, resistance controlled from outside the case. Positive and certain feed.

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Use this wire for Electric-Bell service. It discovers and reports fire automatically.

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We have never failed to receive order to equip all new units installed.
We are saving one Company $450.00 a month, the others in proportion.
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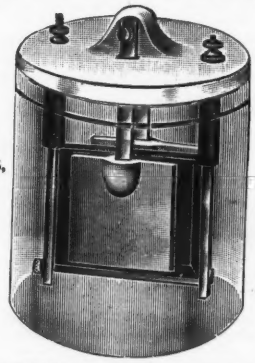

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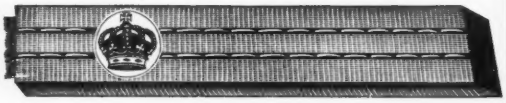

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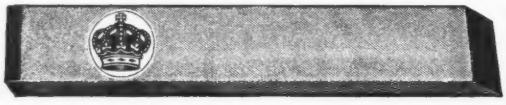

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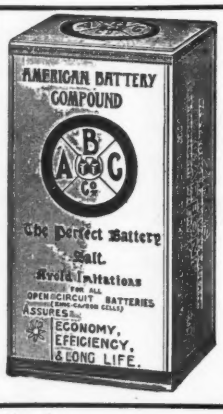

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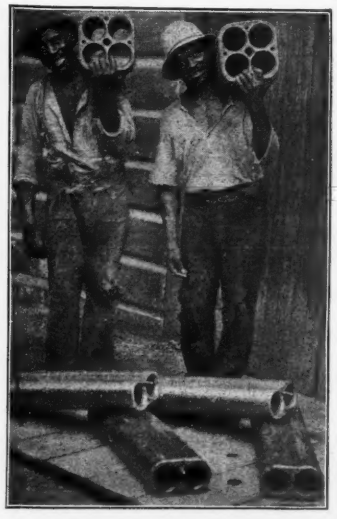

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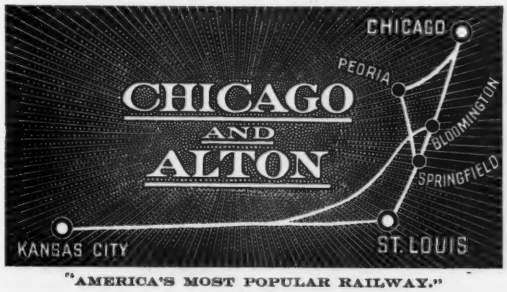

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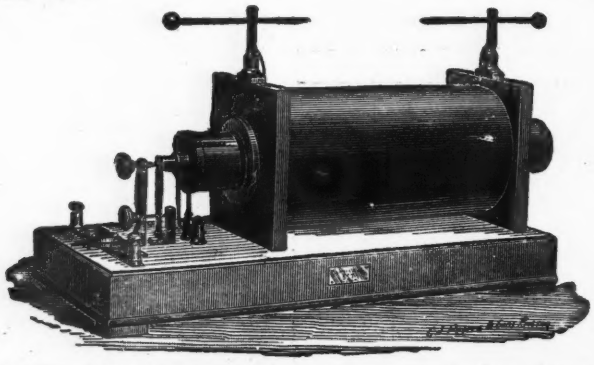

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Full	15.00	144.00	172.69	240.97	82.03
⅞	15.04	138.12	155 03	223.61	84 55
¾	15.11	127.67	133.24	191.06	83.68
⅝	15 88	131.50	112.65	162 80	80 25
½	16.47	136.87	90.04	127.73	75.95

Test of a 35 inch SAMSON, Feb. 1, '97.

Gate Open.	Head.	Rev. Pr Min.	Cu Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.29	194 25	102.02	143.44	81.08
⅞	16.56	187.75	92.13	146.73	84 78
¾	17.33	178.50	83.95	138.40	83.88
⅝	17.54	176.40	68.82	109.64	80.09
½	17.68	168.50	57.69	88 14	76.19

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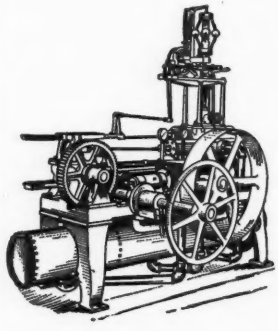

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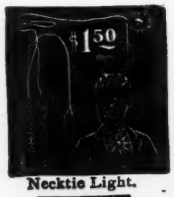
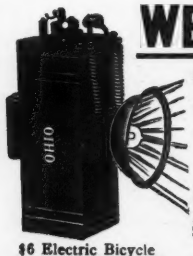


Necktie Light.



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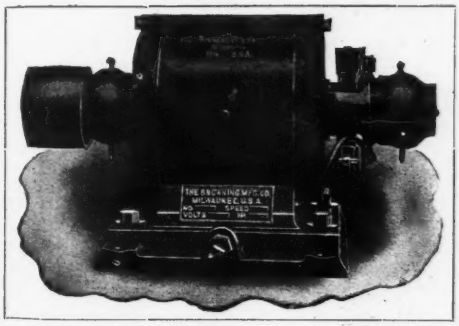

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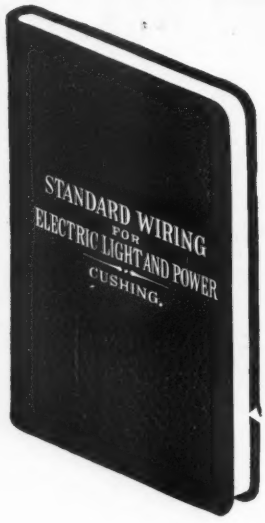
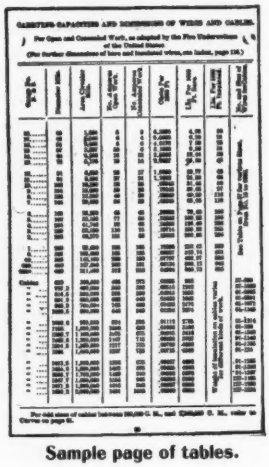
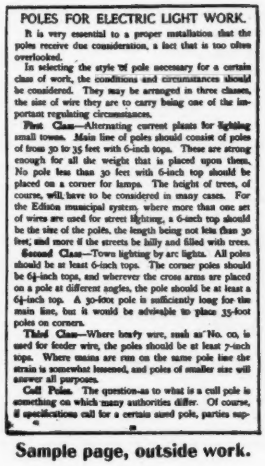
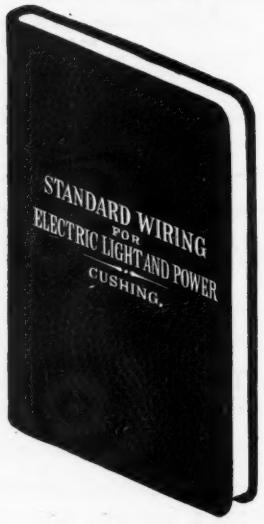




Sample page of tables.



Sample page, outside work.



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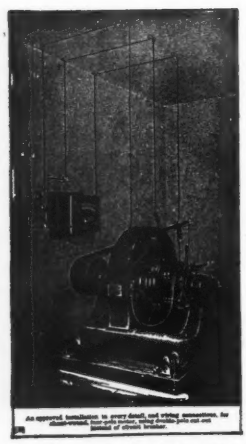
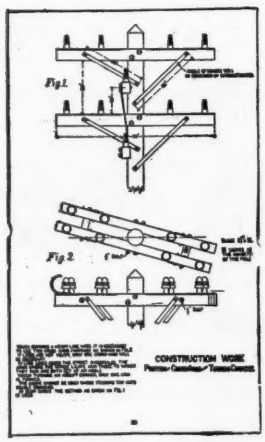
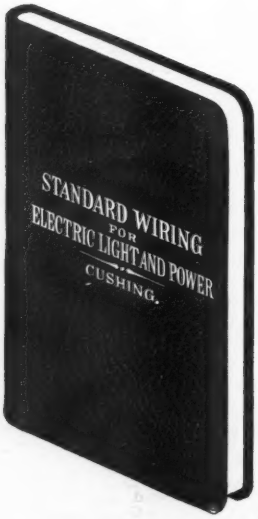
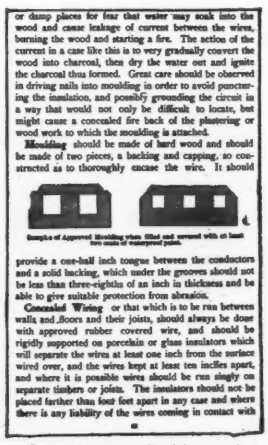


Sample page of construction.

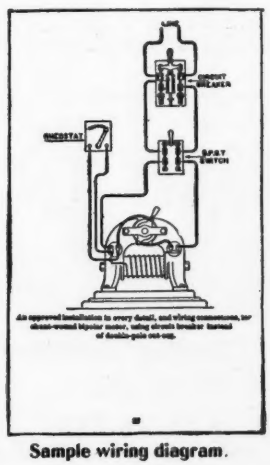


Sample page, pole work.

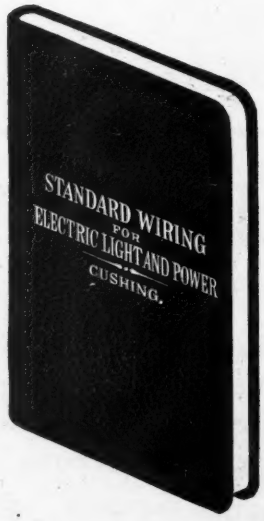


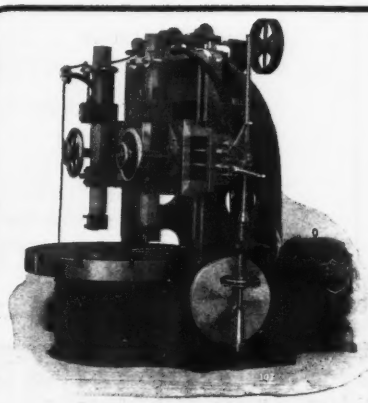


Sample page, inside work.



Sample wiring diagram.





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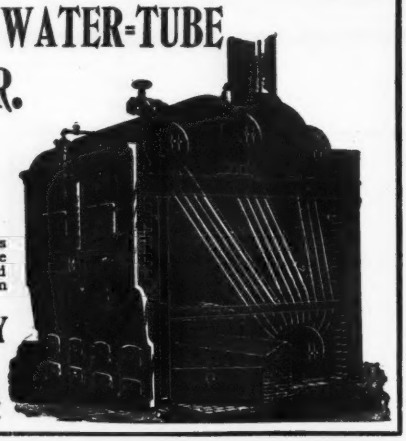

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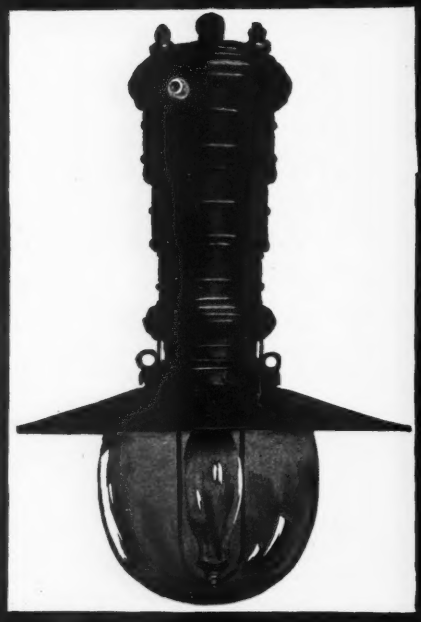

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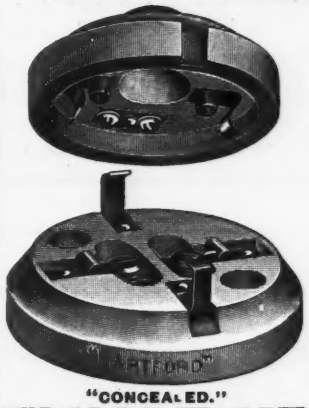

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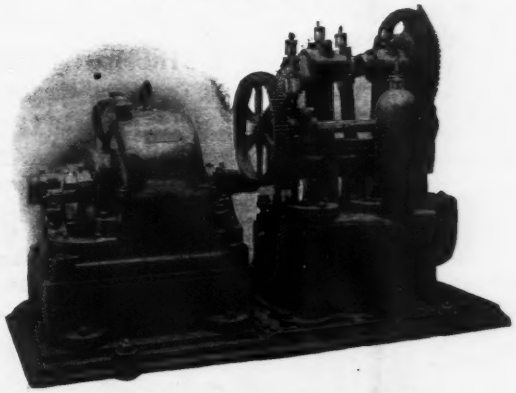

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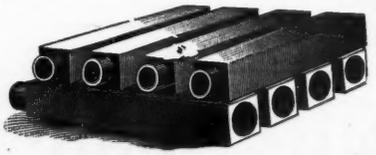

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663,412 Telephone system; W. W. Bennett, Mesquite, Tex.

663,419 Thermostat; H. Cortland, Pittsburgh, Pa.

663,454 Electric arc-lamp; F. W. Martin, Hamilton, Canada.

663,460 Telegraph-repeater; C. D. Olsen, Denver, Colo.

663,461 Maximum demand meter; E. Oxley, Lynn, Mass.—A maximum demand meter comprising a liquid, means for distributing the hydrostatic balance proportionally to the strength of current in a consumption-circuit controlling said fluid and an indicating device to make a continuing indication of the maximum difference of level.

663,465 Programme clock; K. Puttkammer, Charlottenburg, Germany.

663,466 Workman's time-check; K. Puttkammer, Charlottenburg, Germany.

663,489 Electrical connection; W. B. Cleveland, Cleveland, Ohio—Two conductors, the one incorporated in the other in varying degrees of intimacy, and forming at one portion a homogeneous structure with the other.

663,490 Method of forming electrical connections; W. B. Cleveland, Cleveland, Ohio.

663,491 Controller for electric motors; C. A. Dresser, Chicago, Ill.—A solenoid, a hollow core therefor, the movable element of a rheostat controlled by the movement of said core, and a piston within said core to form a dashpot.

663,496 Electric switch; E. M. Hewlett, Schenectady, N. Y.—A blade pivoted to a support, a pair of clips extending through the support and bent to bear against the rear side, a clamp-plate engaging the clips at the front of the support, and a bolt holding the clamp-plate and clip against the support.

663,510 Telephone switchboard; W. S. Paca, Erie, Pa.

663,511 Telephone switchboard apparatus; W. S. Paca, Erie, Pa.

663,519 Electric rail-brake; R. W. M. Schieman, Dresden, Germany.

663,524 Incandescent lamp; S. D. Washburn, Boston, Mass.

663,528 Electrically-operated clip for tentering-machines; W. Whitely, Huddersfield, England.

663,532 Flexible supporting structure for electric lamps; W. F. Brewster, New York, N. Y.—A series of lamp receptacles, a series of link connections between them, and means for defining the positions of the receptacles relative to each other.

663,600 Theo. P. Chandler, Philadelphia, Pa.

663,609 Dynamo or motor; G. L. Martin, New York, N. Y.—A casing provided with poles, comprising a shell integral with said casing and an inserted core extending through said shell and forming a part of the face of the pole.

663,612 Circuit-changer; E. Oxley, Lynn, Mass.—Comprises circuit-terminals, a liquid conductor connecting them, and an insulating-shell movable to surround one terminal and thus to break the circuit.

663,625 System of electric traction; M. T. deFelice, Rome, Italy.

(Continued on page 36.)

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PATENTS.

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663,643 Sparking igniter for explosion engines; F. R. Simms, London, England.

663,653 Electric igniter for gas engines; W. H. Cotton, Chicago, Ill.

663,659 System of electrical distribution; H. R. Kent, New York, N.Y.—A secondary battery and a compound-wound dynamo-electric generator connected to operate in parallel, and the series field-magnet winding of the generator being so connected as to be traversed by the entire current of the system.

663,695 Electrical interrupter; J. M. Davidson, London, England—Comprises a tank, a fluid conductor and a fluid dielectric in said tank, one or more contacts completely immersed in said fluids, an inclined shaft carrying said contacts and means to rotate said shaft.

663,698 Electric arc lamp; J. H. Hallberg, Peabody, Mass.

663,700 Overhead trolley system; C. L. Leiby, Knoxville, Tenn.

663,719 Electrolytic apparatus; H. Becker, Paris, France.

663,724 Blasting; C. F. Bryant, Cripple Creek, Colo.—A blasting device provided with a fuse, a primary igniting device for the fuse comprising a shell engaged by the fuse, terminals forming part of an electric circuit and extending into the said shell, a disk of metallic foil, connecting the terminals and a combustible material arranged between the disk and the fuse.

663,729 Sparking igniter for explosive engines; L. S. Clarke, Ardmore, Pa.

663,740 Trolley for electric cars; W. H. Earl, Painesville, Ohio.

663,750 Electric contact or current-taking device; E. Greil, Paris, France.

663,764 Magnetic separator; E. Kreuser, Mechernich, Germany.

663,767 Fire alarm; R. C. Livingston, Spring Valley, Minn.

663,781 Circuit-breaker; G. W. Parsons, La Grange, Ill.—A contact-blade, a latch for holding said contact-blade in circuit-closing position, a solenoid adapted to be operated by an overload of current in the main line, a core in said solenoid operating to release the holding-latch, and electrically controlled means for regulating a lubricating and retarding liquid to said core.

663,783 Selective-signal system; F. A. Pickernell, Newark, N. J.

663,798 Igniter for explosive-engines; G. A. Tuerk, Chicago, Ill.

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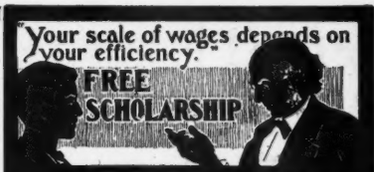

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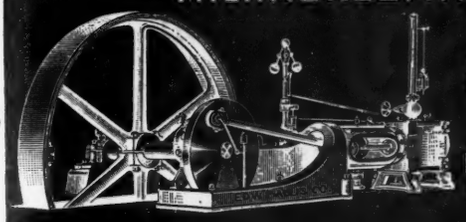

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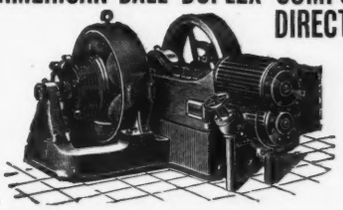

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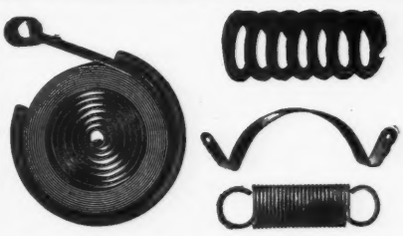

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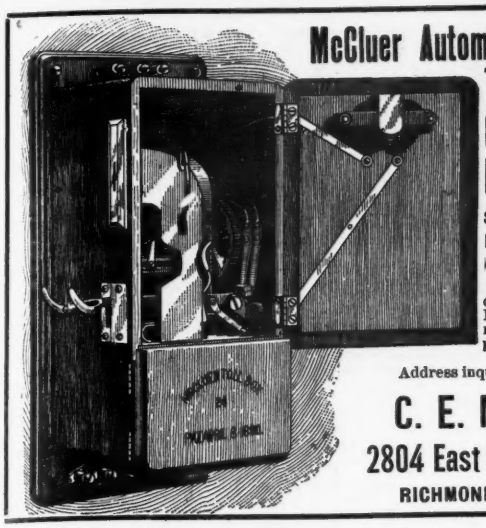

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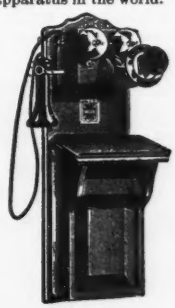

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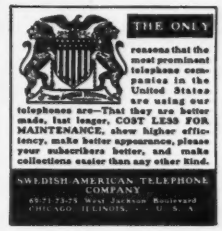
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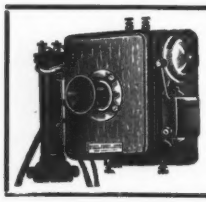

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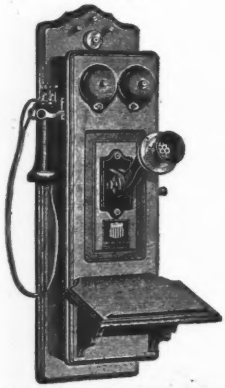

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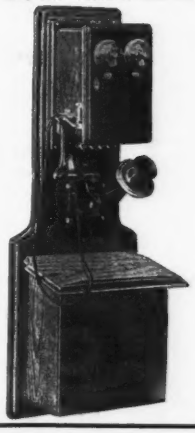

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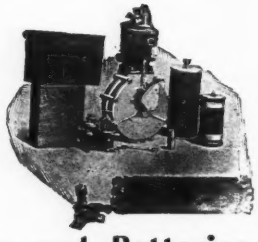

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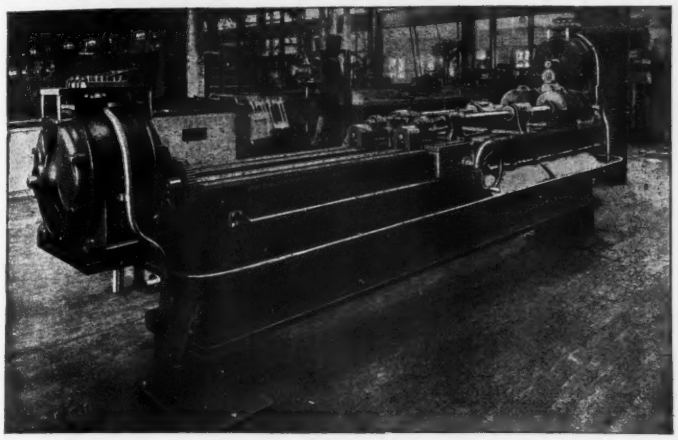

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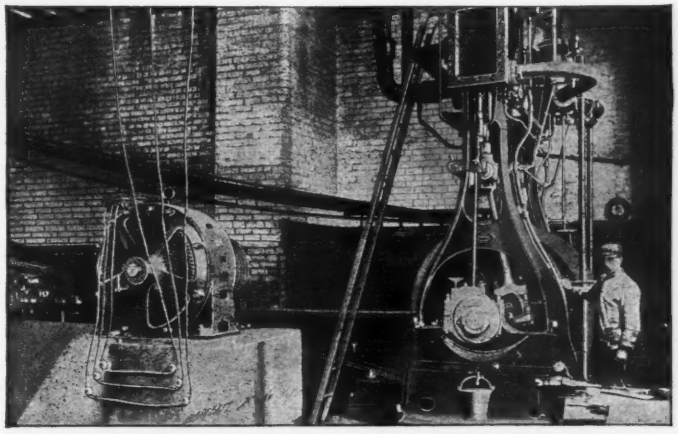

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